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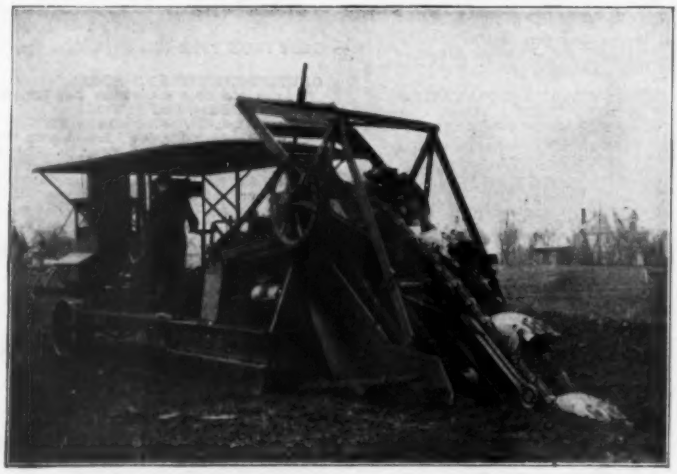

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Heine Chimney Co., Chicago, Ill.
Rust Engineering Co., Pittsburgh, Pa.
Weber Chimney Co., Chicago, Ill.

CHIMNEYS, RADIAL BRICK
Kellogg & Co., M. W., New York.
Rust Engineering Co., Pittsburgh, Pa.
Weber Chimney Co., Chicago, Ill.

CHIMNEYS, STEEL (See Stacks, Steel)

CHLORINATORS
*Wallace & Tiernan Co., Inc., New York.

CHLORINE, LIQUID (See Liquid Chlorine)

CHUTES, CONCRETE
*Ransome Concrete Machy. Co., Dunellen, N. J.
Insley Mfg. Co. Indianapolis, Ind.
Lakewood Engineering Co., Cleveland, O.

CLIPS, WIRE ROPE
*American Steel & Wire Co., Chicago, Ill.
American Hoist & Derrick Co., St. Paul, Minn.
Broderick & Bascom Rope Co., St. Louis, Mo.
Carpenter Co., Geo. B., Chicago, Ill.
Marion Malleable Iron Works, Marion, Ind.
Roebling Sons Co., J. A., Trenton, N. J.
Upson-Walton Co., Cleveland, O.

COAL AND ORE CONVEYING MACHINERY
*Good Roads Mach'y Co., Philadelphia, Pa.
*Haiss Mfg. Co., Geo., New York.
Bartlett & Snow Co., C. O., Cleveland, Ohio.
Blaw-Knox Co., Pittsburgh, Pa.
Brown Hoisting Mchy. Co., Cleveland, O.
Byers Machine Co., J. F., Cleveland, O.
Chain Belt Co., Milwaukee, Wis.
Corrugated Bar Co., Inc., Buffalo, N. Y.
Gifford-Wood Co., Hudson, N. Y.
Hayward Co., New York.
Hunt Co., Inc., C. W., West New Brighton, N. Y.
Jeffrey Mfg. Co., Columbus, O.
Lakeside Bridge & Steel Co., N. Milwaukee, Wis.
Lidgerwood Mfg. Co., New York.
Link-Belt Co., Chicago, Ill.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Portable Machinery Co., Passaic, N. J.
Robins Conveying Belt Co., New York.
Toledo Crane Co., Toledo, O.
Webster Mfg. Co., Chicago, Ill.

COCKS, CURB AND CORPORATION
*Mueller Mfg. Co., H., Decatur, Ill.
*Union Water Meter Co., Worcester, Mass.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Glauber Brass Mfg. Co., Cleveland, O.
Haydenville Co., Haydenville, Mass.

COLUMN CLAMPS
Blaw-Knox Co., Pittsburgh, Pa.
Hydraulic Steelcraft Co., Cleveland, O.
Insley Mfg. Co., Indianapolis, Ind.
Universal Form Clamp Co., Chicago, Ill.

COMPRESSORS, AIR (See Air Compressors)

CONCRETE FLOOR HARDENER
Anti-Hydro Waterproofing Co., New York.
Granitex Corp., New York.
Horn Co., A. C., Long Island City, N. Y.
Master Builders Co., Cleveland, O.
Sonneborn Sons, Inc., L., N. Y. "Lapidolith"

CONCRETE MIXERS
*Austin Machinery Corp'n., Chicago, Ill.
*Jaeger Machine Co., Columbus, O.
*Koehring Machine Co., Milwaukee, Wis.
*Ransome Concrete Machy. Co., Dunellen, N. J.
*Standard Scale & Supply Co., Pittsburgh, Pa.
*Worthington Pump & Mchy. Corp., N. Y. C.
American Cement Machine Co., Keokuk, Ia.
Atlas Engineering Co., Milwaukee, Wis.
Chain Belt Co., Milwaukee, Wis.
Construction Mach'y Co., Waterloo, Iowa.
Contractors' Equipment Co., Keokuk, Ia.
Foote Concrete Mchy. Co., Chicago, Ill.
Gray Iron Fdry. Co., Reading, Pa.
Judy Mfg. Co., Centerville, Ia.
Knickerbocker Co., Jackson, Mich.
Lakewood Engineering Co., Cleveland, O.
Lansing Co., Lansing, Mich.
Oshkosh Mfg. Co., Oshkosh, Wis.
Schramm & Son, Inc., Chris D., Philadelphia, Pa.
Smith Co., T. L., Milwaukee, Wis.

CONCRETE REINFORCEMENT
*American Steel & Wire Co., Chicago, Ill.
*National Steel Fabric Co., Pittsburgh, Pa.
*Truscon Steel Co., Youngstown, O.
Brown Hoisting Mchy. Co., Cleveland, O.
Carnegie Steel Co., Pittsburgh, Pa.
Concrete Steel Co., New York.
Corrugated Bar Co., Inc., Buffalo, N. Y.
Electric Welding Co., Pittsburgh, Pa.
General Fireproofing Co., Youngstown, O.
Inland Steel Co., Chicago, Ill.
Lackawanna Steel Co., Buffalo, N. Y.
Robertson Co., H. H., Pittsburgh, Pa.
Ryerson & Son., J. T., Chicago, Ill.
Wickwire Spencer Steel Corp., Worcester, Mass.

CONDENSERS
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
*Worthington Pump & Mchy. Corp., New York.
Cameron Steam Pump Works, A. S., New York.
Dean Bros. Steam Pump Wks., Indianapolis, Ind.
Ingersoll-Rand Co., New York.
Wheeler Condenser & Eng. Co., Carteret, N. J.

CONDUIT RODS
*Bissell Co., F., Toledo, O.
*Turbine Sewer Machine Co., Milwaukee, Wis.
*Waldo Bros. & Bond Co., Boston, Mass.

CONDUITS
American Vit. Conduit Co., N. Y. C.
Fibre Conduit Co., Orangeburg, N. Y.
Johns-Manville Co., H. W., New York City.
National Metal Moulding Co., N. Y. C.
Youngstown Sheet & Tube Co., Youngstown, O.

CONTRACTORS' SUPPLIES, DEALERS
Carpenter Co., Geo. B., Chicago, Ill.
Shannon & Co., J. Jacob, Philadelphia, Pa.

CONTRACTORS' USED EQUIPMENT
*Craven Co., Frank T., New York, N. Y.
*King, Philip T., New York, N. Y.
*Titan Equipment Co., New York, N. Y.
*Zelnicker Supply Co., Walter A., St. Louis, Mo.
Contractors' Mach. & Supply Co., Pittsburgh, Pa.

CONVEYORS, BELT
*Good Roads Mach'y Co., Philadelphia, Pa.
*Haiss Mfg. Co., Geo., New York.
*Russell Grader Mfg. Co., Minneapolis, Minn.
Barber-Greene Co., Aurora, Ill.
Gifford Wood Co., Hudson, N. Y.
Goodyear Tire & Rubber Co., Akron, O.
Imperial Belting Co., Chicago, Ill.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.
Portable Mchy. Co., Passaic, N. J.
Republic Rubber Co., Youngstown, O.
Robins Conv. Belt Co., N. Y. C.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

** Indicates that the manufacturer carries an advertisement.* *See index facing inside back cover.*

Cletrac's Power Moves the Dirt

For speed on an excavation job, hitch the powerful Cletrac to a five foot Fresno Scraper. It handles 16 cubic feet of earth at a trip and makes twice as many trips as horses can.

And since it takes *four* horses to handle a Fresno of the same size, you can easily see that *one* Cletrac does the work of *eight* horses and two men.

Write today for information on original cost and cost of upkeep of this tractor and compare these figures with your own on horses. Then get in touch with the Cletrac dealer near you.

SPECIFICATIONS

Horsepower: 12 at drawbar, 20 at belt-pulley
Length: 96 inches
Width: 50 inches
Height: 52 inches
Weight: 3455 pounds
Turning Circle: 12 feet
Traction Surface: About 800 square inches
Center to Center of Tracks: 38 inches
Belt Pulley: Diameter 8 inches, face 6 inches

THE CLEVELAND TRACTOR CO.

"Largest Producers of Tank-Type Tractors in the World"

19211 Euclid Ave. Cleveland, Ohio.

Cletrac
TANK-TYPE TRACTOR

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*Haiss Mfg. Co., Geo., New York.
*Russell Grader Mfg. Co., Minneapolis, Minn.
Atlas Engineering Co., Milwaukee, Wis.
Bartlett & Snow Co., C. O., Cleveland, O.
Chain Belt Co., Milwaukee, Wis.
Gifford Wood Co., Hudson, N. Y.
Godfrey Conveyor Co., Elkhart, Ind.
Guarantee Constn. Co., New York.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Republic Rubber Co., Youngstown, O.
Robins Conv. Belt Co., N. Y. C.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

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*Bucyrus Co., South Milwaukee, Wis.
*Pawling & Harnischfeger Co., Milwaukee, Wis.
*Thew Shovel Co., Lorain, O.
American Hoist & Derrick Co., St. Paul, Minn.
Brown Hoisting Mchy. Co., Cleveland, O.
Browning Co., Cleveland, O.
Davenport Locomotive Works, Davenport, Ia.
Industrial Works, Bay City, Mich.
Link-Belt Co., Chicago, Ill.
Locomotive Crane Co. of America, Chicago, Ill.
Marion Steam Shovel Co., Marion, O.
McMyler Interstate Co., Cleveland, O.
Northwest Engineering Works, Chicago, Ill.
Orton & Steinbrenner Co., Chicago, Ill.
Ohio Locomotive Crane Co., Bucyrus, O.
Osgood Co., The, Marion, O.
Overland Crane Co., Hammond, Ind.
U. S. Crane Co., Chicago, Ill.

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Brown Hoisting Mchy. Co., Cleveland, O.
Chesapeake Iron Works, Baltimore, Md.
Link-Belt Co., Chicago, Ill.
Northern Eng. Works, Detroit, Mich.
Speidel, J. G., Reading, Pa.
Terry Mfg. Co., Edw. F., N. Y. C.
Toledo Bridge & Crane Co., Toledo, O.
U. S. Crane Co., Chicago, Ill.
Whiting Corp'n, Harvey, Ill.

CRANES, WRECKING
*Bucyrus Co., South Milwaukee, Wis.
Browning Co., Cleveland, O.
Industrial Works, Bay City, Mich.
U. S. Crane Co., Chicago, Ill.

CREOSOTED BLOCKS, TIMBER, ETC.
*Republic Creosoting Co., Indianapolis, Ind.
American Creosoting Co., N. Y. C.
American Creosote Works, Inc., N. Orleans, La.
Jennison-Wright Co., Toledo, O.
Southern Paving Constr. Co., Chattanooga, Tenn.
Southern Wood Pres. Co., Atlanta, Ga.
Wyckoff Pipe & Creosoting Co., New York.

CREOSOTING AND CREOSOTING OILS
*Barrett Co., New York.
Am. Creosote Wks., Inc., New Orleans, La.
Jennison-Wright Co., Toledo, O.
Southern Creosoting Co., Ltd., Slidell, La.
Southern Paving Const. Co., Chattanooga, Tenn.
Wyckoff Pipe & Creosoting Co., New York.

CRUSHERS AND PULVERIZERS (See Rock Crushers)

CULVERTS, METAL
*American Cast Iron Pipe Co., Birmingham, Ala
*Dee Co., W. E., Chicago, Ill.
*Good Roads Machinery Co., Philadelphia, Pa.
*Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
*Newport Culvert Co., Newport, Ky.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Truscon Steel Co., Youngstown, O.
*U. S. C. I. Pipe & Fdry. Co., Burlington, N. J.
*Wood & Co., R. D., Philadelphia, Pa.
American Rolling Mill Co., Middletown, O.
Berger Mfg. Co., Canton, O.
Canton Culvert & Silo Co., Canton, O.
Edwards Mfg. Co., Cincinnati, O.
Gallon Iron Works & Mfg. Co., Gallon, O.
Hardesty Mfg. Co., The R., Denver, Colo.
Madison Foundry Co., Cleveland, O.
Southern Metal Culvert Co., Salisbury, N. C.
Wheeling Corrugating Co., Wheeling, W. Va.

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*Casey-Hedges Co., Chattanooga, Tenn.
*Clark Co., H. W., Mattoon, Ill.
*Mueller Mfg. Co., Decatur, Ill.
*Thompson-Fleming Co., Inc., Buffalo, N. Y.
Clow & Sons, J. B., Chicago, Ill.
Madison Foundry Co., Cleveland, O.
S. E. T. Valve & Hydrant Co., N. Y. C.

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*National Steel Fabric Co., Pittsburgh, Pa.
*Truscon Steel Co., Youngstown, O.
Concrete Steel Co., New York.
Steel Protected Concrete Co., Philadelphia, Pa.

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*Smith Mfg. Co., A. P., East Orange, N. J.
Armstrong Mfg. Co., Bridgeport, Conn.
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Erie Tool Works, Erie, Pa.
Greenfield Tap & Die Corp'n., Greenfield, Mass.
Walworth Mfg. Co., Boston, Mass.

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*Worthington Pump & Mchy. Corp., New York.
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Helwig Mfg. Co., St. Paul, Minn.

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Carpenter & Co., Geo. B., Chicago, Ill.
Clyde Iron Works, Duluth, Minn.
Federal Bridge & Struc. Co., Waukesha, Wis.
Flory Mfg. Co., S., Bangor, Pa.
Insley Mfg. Co., Indianapolis, Ind.
Lakeside Bridge & Steel Co., N. Milwaukee, Wis.
Lidgerwood Manufacturing Co., New York.
Lincoln Iron Works, Rutland, Vt.
National Hoisting Engine Co., Harrison, N. J.
Smith, Whitcomb & Cook Co., Barrie, Vt.
Superior Iron Works, Superior, Wis.
Terry Mfg. Co., Edw. F., New York.

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*Mueller Mfg. Co., H., Decatur, Ill.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Lidgerwood Manufacturing Co., New York.

DERRICKS, REVOLVING
Clyde Iron Works, Duluth, Minn.
Lidgerwood Manufacturing Co., New York.
Terry Mfg. Co., Edw. F., New York.

DERRICKS, STEEL
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American Hoist & Derrick Co., St. Paul, Minn.
Clyde Iron Works, Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Federal Bridge & Struc. Co., Waukesha, Wis.
Hayward Co., New York.
Insley Mfg. Co., Indianapolis, Ind.
Lakeside Bridge & Steel Co., N. Milwaukee, Wis.
Lidgerwood Manufacturing Co., New York.
Petroleum Iron Works Co., Sharon, Pa.
Taylor Portable Steel Derrick Co., Chicago, Ill.
Terry Mfg. Co., Edw. F., New York.

DERRICKS, STEEL PORTABLE
*Austin Mach. Corp., Chicago, Ill.
Blaw-Knox Co., Pittsburgh, Pa.
Clyde Iron Works, Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Lidgerwood Manufacturing Co., New York.
Taylor Portable Steel Derrick Co., Chicago, Ill.

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*Austin Mach. Corp., Chicago, Ill.
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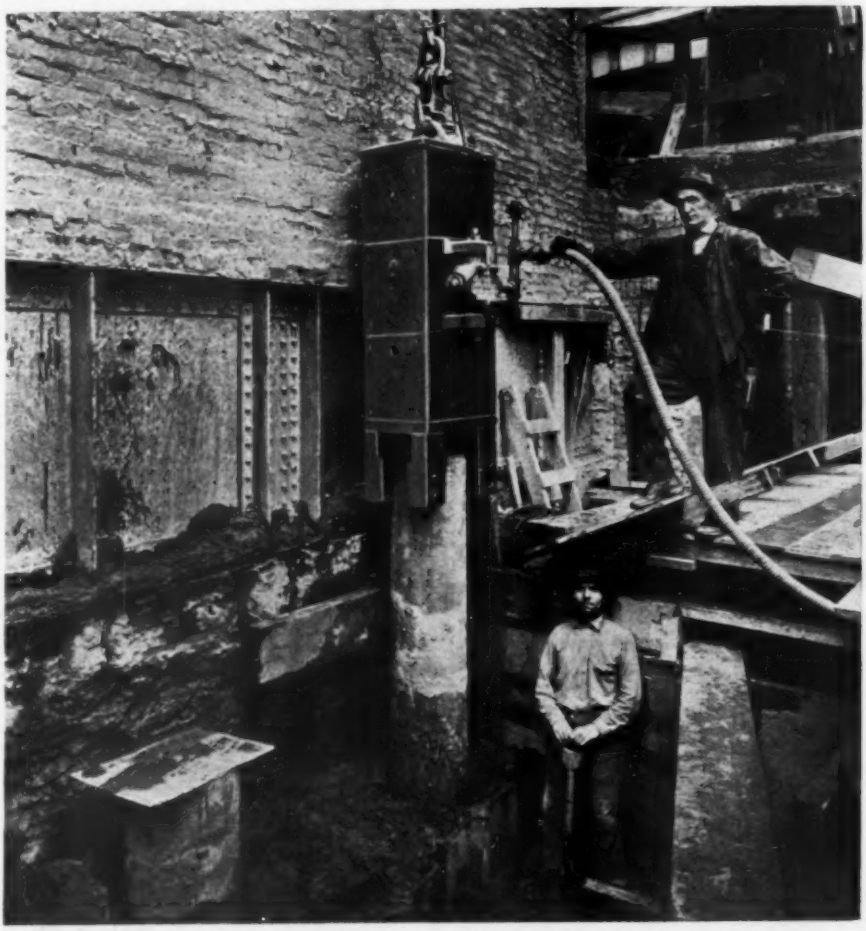
Byers Machine Co., J. F., Ravenna, O.
Clyde Iron Works, Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Hayward Co., New York.
Hoisting Engine Sales Co., New York.
National Hoisting Engine Co., Harrison, N. J.
Orton & Steinbrenner Co., Chicago, Ill.
Terry Mfg. Co., Edward F., New York.



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Fourteen inch Steel Pipe Piles driven for reinforcement between double rows of 15-in. Steel Sheet Piling grouped to form concrete pier foundations. The piling and pipe piles were both driven to hardpan with a No. 7 hammer swung from the end of a derrick boom. The character of the ground made foundation piling work difficult. The job was completed in record time with the aid of five McKiernan-Terry Pile Hammers which always show up best when the driving is most difficult.

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Rock Drills—Pile Hammers—Lifting Jacks
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*Koehring Machine Co., Milwaukee, Wis.
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Archer Iron Works, Chicago, Ill.
Insley Mfg. Co., Indianapolis, Ind.
Lakewood Engineering Co., Cleveland, O.
Pneumatic Concrete Machinery Co., New York.

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Dietzgen Co., E., New York.
Gurley, W. & L. E., Troy, N. Y.
Hamilton Mfg. Co., Two Rivers, Wis.
Keuffel & Esser Co., Hoboken, N. J.
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Spaulding-Moss Co., Boston, Mass.

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Hayward Co., New York.
Lidgerwood Mfg. Co., New York.
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Osgood Co., The, Marion, O.
Stockton Iron Works, Stockton, Cal.
Superior Iron Works, Superior, Wis.
Vulcan Iron Works, Jersey City, N. J.

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*Austin Machinery Corp'n., Chicago, Ill.
*Bucyrus Co., South Milwaukee, Wis.
American Steel Dredge Co., Fort Wayne, Ind.
Fairbanks Steam Shovel Co., Marion, O.
Marion Steam Shovel Co., Marion, O.
Osgood Co., Marion, O.

DREDGES, HYDRAULIC
*Bucyrus Co., South Milwaukee, Wis.
Ellicott Mach. Corp., Baltimore, Md.
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Marion Steam Shovel Co., Marion, O.
Morris Machine Works, Baldwinsville, N. Y.

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*McKiernan-Terry Drill Co., New York.
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Cleveland Pneumatic Tool Co., Cleveland, O.
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Helwig Mfg. Co., St. Paul, Minn.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Sullivan Machinery Co., Chicago, Ill.

DRILLS, CORE
*McKiernan-Terry Drill Co., New York.
Dobbins Core Drill Co., Inc., New York.
Ingersoll-Rand Co., New York.
Standard Diamond Drill Co., Chicago, Ill.
Sullivan Machinery Co., Chicago, Ill.

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Cleveland Pneumatic Tool Co., Cleveland, O.
Cleveland Rock Drill Co., Cleveland, O.
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Helwig Mfg. Co., St. Paul, Minn.
Ingersoll-Rand Co., New York.
Sullivan Machinery Co., Chicago, Ill.

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Ingersoll-Rand Co., New York.
Sullivan Machinery Co., Chicago, Ill.
Wood Drill Works, Paterson, N. J.

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Hayward Co., New York.
Monighan Machine Co., Chicago, Ill.

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American Process Co., New York.
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Cummer & Son Co., F. D., Cleveland, O.
East Iron & Machine Co., Lima, O.
Ruggles-Coles Eng. Co., New York.
Variety Iron & Steel Works, Cleveland, O.

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*Heil Company, Milwaukee, Wis.
*Leo Trailer & Body Co., Chicago, Ill.
*Littleford Bros., Cincinnati, O.
Archer Iron Works, Chicago, Ill.
Auto Truck Steel Body Co., Chicago, Ill.
Columbian Steel Tank Co., Kansas City, Mo.
Horizontal Hydraulic Hoist Co., Milwaukee, Wis.
Simplex Mfg. Co., Conneautville, Pa.
Van Dorn Iron Wks., Cleveland, Ohio.
Wood Hydraulic Hoist & Body Co., Detroit, Mich.

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*Acme Road Machinery Co., Frankfort, N. Y.
*Arcadia Trailer Corp., Newark, N. Y.
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*Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Tiffin Wagon Co., Tiffin, Ohio.
Acme Wagon Co., Emigsville, Pa.
Austin Mfg. Co., Chicago, Ill.
Eagle Wagon Works, Auburn, N. Y.
Holzbog & Bro., Geo. H., Jeffersonville, Ind.
Stroud & Co., Omaha, Nebr.
Watson Products Corp., Canastota, N. Y.

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*Barrett Co., New York.
*Dow Chemical Co., Midland, Mich.
*Dustoline for Roads Co., Summit, N. J.
*Semet-Solvay Co., Solvay, N. Y.
*Standard Oil Co. of Indiana, Chicago, Ill.
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EJECTORS, SEWAGE
*Pacific Flush Tank Co., Chicago, Ill.
*Yeomans Bros. Co., Chicago, Ill.

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*Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.
Gregory Electric Co., Chicago, Ill.
Ideal Elec. & Mfg. Co., Mansfield, O.
Triumph Electric Co., Cincinnati, O.
Western Electric Co., New York.

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*General Electric Co., Schenectady, N. Y.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

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*Worthington Pump & Mach. Corp., New York City
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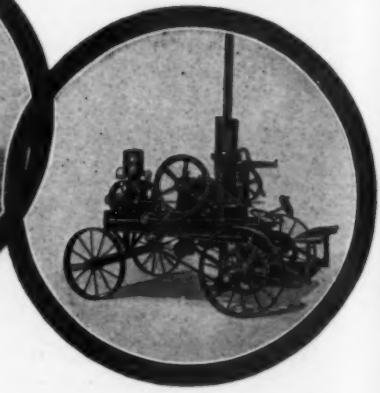
Buy Them as a Unit

WHEEL TYPE
P&H
EXCAVATOR

POWER TRACTION
P&H BACKFILLER



POWER TRACTION
P&H TAMPER

The purchase of a P & H Trenching Unit is a terse answer to the question of city trenching.

On city streets where work must be done with uniformity, and dispatch, the P & H combination —Excavator, Backfiller, and Tamper—is the logical equipment for the job.

Excavating: **steady and fast with none of the irregularity and time consumption of human labor and at a cost that shows big in net savings.**

Backfilling: **getting the backfill back, and out of the way of traffic, in a hurry, and on one man's time.**

Tamping: **Finishing up a good job by ramming the backfill back to stay and with no danger of settling pavement later.**

Real facts and figures on P & H Excavating Equipment are waiting for you, let us give some interesting and valuable data,—send for Bulletin X and Bulletin IX.

PAWLING & HARNISCHFEGER CO.

EST. 1884
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1241 Monadnock Block, Chicago, Ill.
Pittock Block, Portland, Ore.
1125 Central Building, Los Angeles, Cal.
821 Monadnock Bldg., San Francisco, Cal.

"You see them wherever you go, and they go wherever you see them"

P&H — excavators — back-fillers - tampers

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*General Electric Co., Schenectady, N. Y.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

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*General Electric Co., Schenectady, New York.
*Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.
Kuhlman Electric Co., Bay City, Mich.

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*American Steel & Wire Co., Chicago, Ill.
*General Electric Co., Schenectady, N. Y.
*Habirshaw Elec. Cable Co., New York.
*Hazard Mfg. Co., Wilkesbarre, Pa.
*Simplex Wire & Cable Co., Boston, Mass.

ELEVATORS, BUCKET
*Austin Western Road Machy. Co., Chicago, Ill.
*Good Roads Mach'y Co., Philadelphia, Pa.
*Haiss Mfg. Co., Geo., New York.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Worthington Pump & Mchy. Works, New York.
Bartlett & Snow Co., C. O., Cleveland, Ohio.
Chain Belt Co., Milwaukee, Wis.
Gifford-Wood Co., Hudson, N. Y.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.
Republic Rubber Co., Youngstown, O.
Robins Conv. Belt Co., N. Y. C.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

ELEVATORS, CONTRACTING MATERIAL
*Ransome Concrete Machy. Co., Dunellen, N. J.
American Hoist & Derrick Co., St. Paul, Minn.
Byers Machine Co., J. F., Ravenna, O.
C. H. & E. Mfg. Co., Milwaukee, Wis.
Insley Mfg. Co., Indianapolis, Ind.
Smith Co., T. L., Milwaukee, Wis.

ELEVATORS, FACTORY
Otis Elevator Co., New York.
Ridgway & Son Co., C., Coatesville, Pa.
Speidel, J. G., Reading, Pa.
Webster Mfg. Co., Chicago, Ill.

ENGINES, GAS AND GASOLINE
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Fairbanks, Morse & Co., Chicago, Ill.
*Holt Mfg. Co., Peoria, Ill.
*Pittsburgh Filter & Eng. Co., Pittsburgh, Pa.
*Standard Scale & Supply Co., Pittsburgh, Pa.
*Worthington Pump & Mchy. Corp., New York.
C. H. & E. Mfg. Co., Milwaukee, Wis.
Chicago Pneumatic Tool Co., New York.
Domestic Engine & Pump Co., Shippensburg, Pa.
Foos Gas Engine Co., Springfield, Ohio.
Universal Motor Co., Oshkosh, Wis.
Weber Engine Co., Kansas City, Mo.

ENGINES, HIGH DUTY WATER-WORKS
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*De Laval Steam Turbine Co., Trenton, N. J.
*Fairbanks, Morse & Co., Chicago, Ill.
*Worthington Pump & Mchy. Corp., New York.
Morris Machine Works, Baldwinsville, N. Y.
Murray Iron Works Co., Burlington, Ia.

ENGINES, OIL
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Bush-Sulzer Bros.-Diesel Eng. Co., St. Louis, Mo.
*Fairbanks, Morse & Co., Chicago, Ill.
*Midwest Engine Co., Indianapolis, Ind.
*Nordberg Mfg. Co., Milwaukee, Wis.
*Pittsburgh Filter & Eng. Co., Pittsburgh, Pa.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
*Worthington Pump & Mchy. Corp., New York.
Advance Rumely Thresher Co., La Porte, Ind.
Bessemer Gas Eng. Co., Grove City, Pa.
Chicago Pneumatic Tool Co., Chicago, Ill.
De La Vergne Machine Co., New York.
Foos Gas Engine Co., Springfield, O.
Ingersoll-Rand Co., New York.
International Harvester Co. of Am., Chicago, Ill.
Machinery Sales Co., Chicago, Ill.
Weber Engine Co., Kansas City, Mo.

ENGINES, PUMPING
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Dayton-Dowd Co., Quincy, Ill.
*Fairbanks Morse & Co., Chicago, Ill.
*Nordberg Mfg. Co., Milwaukee, Wis.
*United Iron Wks., Inc., Kansas City, Mo.
*Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
*Worthington Pump & Machy. Corp., New York.
American Gas Engine Co., Kansas City, Mo.
American Well Works, Aurora, Ill.
Deming Co., Salem, O.
Enterprise Mchy. Co., Minneapolis, Minn.
Weinman Pump Mfg. Co., Columbus, O.

ENGINES, STEAM
*Allis-Chalmers Mfg. Co., Milwaukee, Wis.
*Nordberg Mfg. Co., Milwaukee, Wis.
Ball Engine Co., Erie, Pa.
Dake Engine Co., Grand Haven, Mich.
Erie Pump & Engine Co., Medina, N. Y.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Leffel Co., J., Springfield, O.
Morris Machine Works, Baldwinsville, N. Y.
Murray Iron Works Co., Burlington, Ia.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

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*Fairbanks, Morse & Co., Chicago, Ill.
*Holt Mfg. Co., Peoria, Ill.
Oliver Tractor Co., Knoxville, Tenn.
Phoenix Mfg. Co., Eau Claire, Wis.

EXCAVATING MACHINERY. (See Names Under Excavators, also Steam Shovels)

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Ball Eng. Co., Erie, Pa.
Blaw-Knox Co., Pittsburgh, Pa.
Byers Machine Co., J. F., Ravenna, O.
Lidgerwood Mfg. Co., New York.
Marion Steam Shovel Co., Marion, O.
Smith Co., T. L., Milwaukee, Wis.

EXCAVATORS, DITCH AND TRENCH
*Austin Machinery Corp'n., Chicago, Ill.
*Baker Mfg. Co., Springfield, Ill.
*Bucyrus Co., South Milwaukee, Wis.
*Pawling & Harnischfeger Co., Milwaukee, Wis.
*Russell Grader Mfg. Co., Minneapolis, Minn.
American Hoist & Derrick Co., St. Paul, Minn.
Ball Engine Co., Erie, Pa.
Bay City Dredge Works, Bay City, Mich.
Buckeye Traction Ditcher Co., Findlay, O.
Byers Machine Co., J. F., Ravenna, O.
Clyde Iron Works, Duluth, Minn.
Fairbanks Steam Shovel Co., Marion, O.
Hayward Co., The, New York City.
Keystone Driller Co., Beaver Falls, Pa.
Marion Steam Shovel Co., Marion, O.
Monighan Machine Co., Chicago, Ill.
Osgood Co., Marion, O.
Parsons Co., Newton, Ia.

EXCAVATORS, DRAG-LINE
*Austin Machinery Corp'n., Chicago, Ill.
*Bucyrus Co., South Milwaukee, Wis.
*Pawling & Harnischfeger Co., Milwaukee, Wis.
Byers Machine Co., J. F., Ravenna, O.
Clyde Iron Works, Duluth, Minn.
Hayward Co., New York.
Industrial Works, Bay City, Mich.
Link-Belt Co., Chicago, Ill.
Marion Steam Shovel Co., Marion, O.
Monighan Machine Co., Chicago, Ill.
Osgood Co., Marion, O.
Parsons Co., Newton, Ia.
Smith Co., T. L., Milwaukee, Wis.

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Anchor Post Iron Works, New York.
Cyclone Fence Co., Waukegan, Ill.
Frost-Superior Fence Co., Cleveland, O.
Indiana Steel & Wire Co., Muncie, Ind.
Pittsburgh Steel Co., Pittsburgh, Pa.
Stewart Iron Works, Cincinnati, Ohio.
Texas Cyclone Fence Co., Fort Worth, Tex.
Wickwire Spencer Steel Corp'n, Worcester, Mass.

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Berger Mfg. Co., Canton, O.
Van Dorn Iron Works, Cleveland, O.

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Cummer & Son Co., F. D., Cleveland, O.
Decarie Incinerator Co., Minneapolis, Minn.
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*Tiffin Wagon Co., Tiffin, O.
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*Pittsburg Meter Co., East Pittsburgh, Pa.

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Camden Iron Works, Camden, N. J.

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*Fairbanks, Morse & Co., Chicago, Ill.
*Waldo Bros. & Bond Co., Boston, Mass.
*Worthington Pump & Mchy. Corp., New York.
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*Chicago Bridge & Iron Works, Chicago, Ill.
*Heil Co., Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
*United Iron Works, Kansas City, Mo.
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Byers Mach. Co., J. F., Ravenna, Ohio.
Scaife & Sons, Wm. B., Oakmont, Pa.
Wayne Oil Tank & Pump Co., Ft. Wayne, Ind.

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*Columbian Iron Works, Chattanooga, Tenn.
*Crane Co., Chicago, Ill.
*Eddy Valve Co., Waterford, N. Y.
*Kennedy Valve Mfg. Co., Elmira, N. Y.
*Ludlow Valve Mfg. Co., Troy, N. Y.
*Rensselaer Valve Co., Troy, N. Y.
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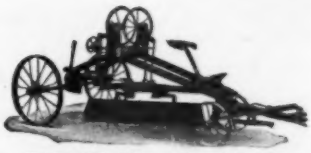

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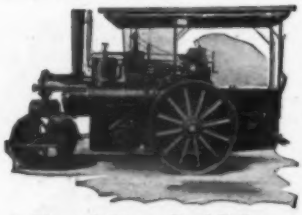

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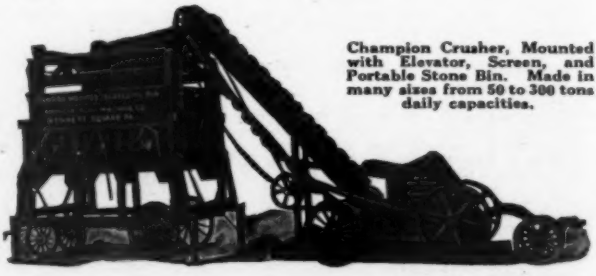

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Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
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Ingersoll-Rand Co., New York.
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Northern Eng. Works, Detroit, Mich.

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Domestic Engine & Pump Co., Shippensburg, Pa.
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Monighan Machine Co., Chicago, Ill.
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Flory Mfg. Co., S., Bangor, Pa.
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Ingersoll-Rand Co., New York.
Insley Mfg. Co., Indianapolis, Ind.
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Flory Mfg. Co., Bangor, Pa.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Northern Engineering Works, Detroit, Mich.

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*Kennedy Valve Mfg. Co., Elmira, N. Y.
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*Norwood Engineering Co, Florence, Mass.
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Aloe Co., A. S., St. Louis, Mo.
Berger & Sons, C. L., Boston, Mass.
Brandis & Sons Mfg. Co., Brooklyn, N. Y.
Buff & Buff Mfg. Co., Boston, Mass.
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Gurley, W. & L. E., Troy, N. Y.
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*Indicates that the manufacturer carries an advertisement. See index facing inside back cover.

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"They saved us a lot of time on this job, Boss," agreed the Foreman. "It took only a quarter as long as if we had used ordinary timber bracing. Not only can you put them in more quickly, but fewer braces are needed."

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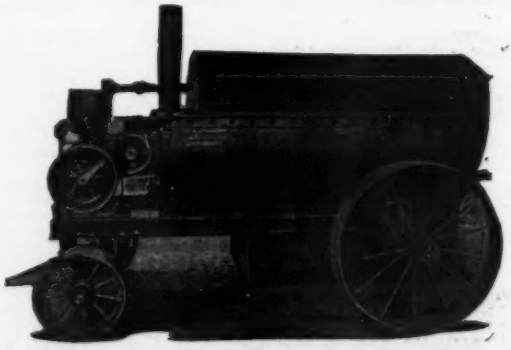

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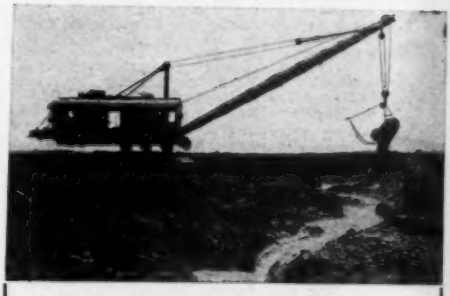

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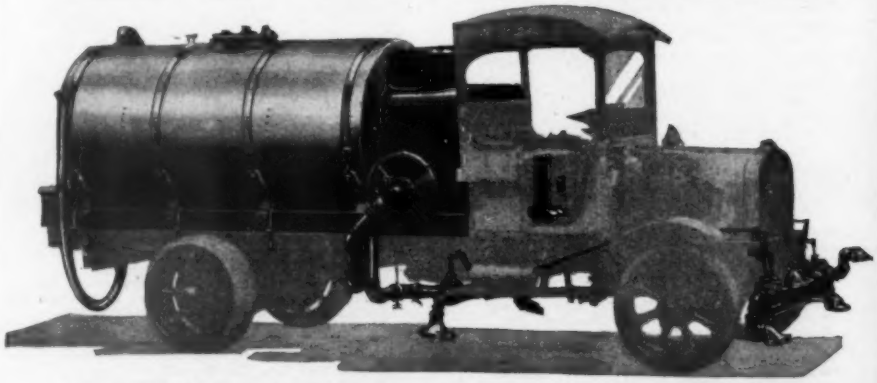

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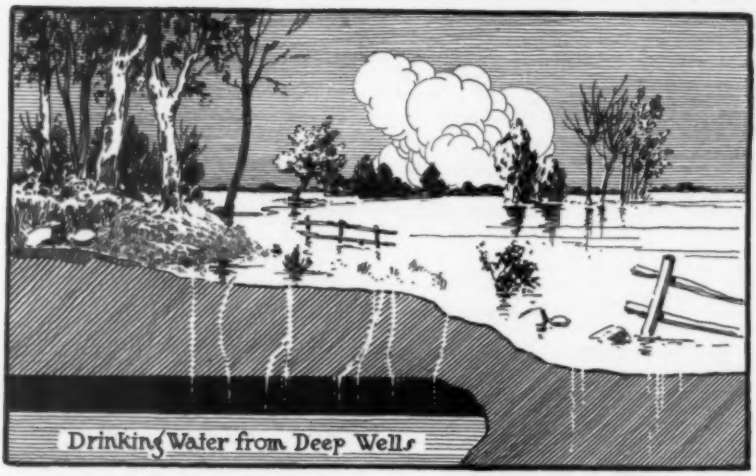

A Flood caused the Chemung River to overflow—the polluted water seeped into the wells used for the public water supply—and Corning suffered a Typhoid epidemic.

It Happened Once—It May Happen Again—But Not at Corning

How often do we hear someone say "Oh, our water supply is from wells—and of course it is absolutely pure!" But is it?

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Here the Chemung River passed near the wells from which Corning obtained its water supply. A flood came. The surrounding country was inundated—the well water became polluted and an epidemic of Typhoid fever resulted.

Here is another instance of an entirely preventable Typhoid Fever Epidemic. The flooding of the Chemung River could not have been prevented—possibly the entrance of polluted water into the wells could not have been prevented—*but*——the *typhoid fever epedemic could have been prevented* had the water supply been Sterilized!

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Over four thousand installations of W & T apparatus sterilizing more than *Three Billion Gallons* of water each day testify to the worth of the process and equipment.

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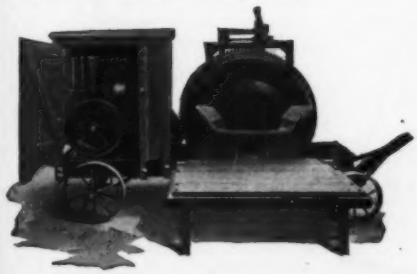

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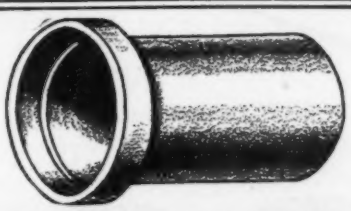

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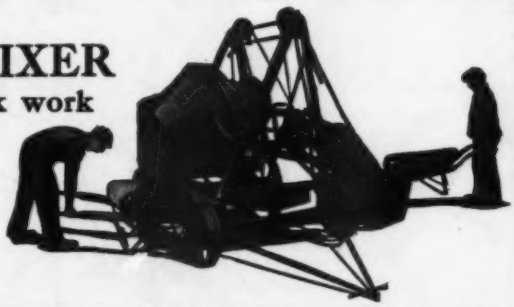

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HARRY M. WAUGH
BUILDING CONTRACTOR

Gentlemen:

I received the repair parts for the mixer, and I take this opportunity to thank you for your promptness as you did.

It is unusual to write a letter of this kind, but it has been so long since I have known any machinery company to show such interest in my welfare that I was forced to say something about this.

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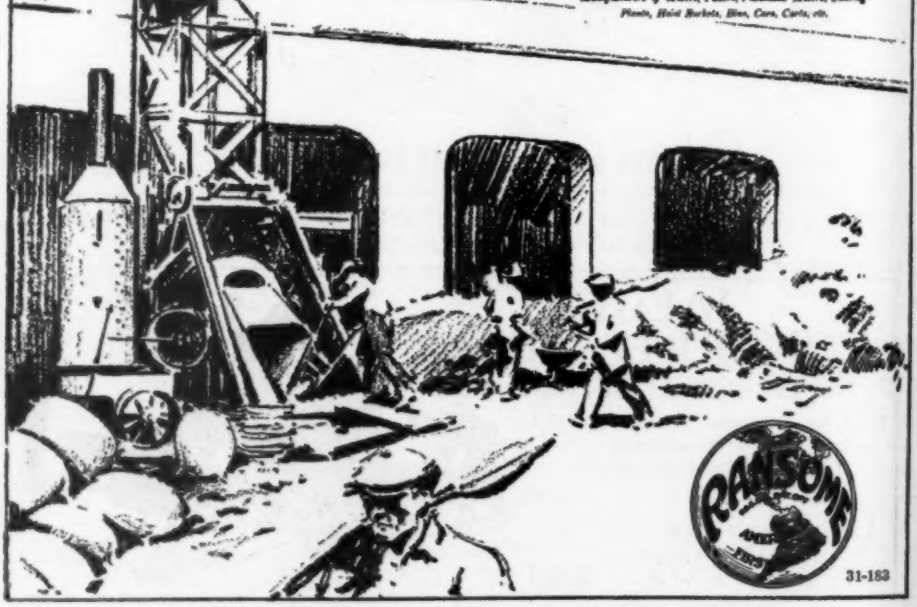
Manufacturers of Mixers, Pavers, Pneumatic Mixers, Clutching Plants, Hoist Buckets, Bins, Cars, Carts, etc.



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Contractors' & Engineers' Monthly

New York March, 1921

An Iowa Contractor Makes His Road Jobs Pay

Concrete Foundations for Shed and Mixer Plant—Pavements for Trucks and Loading Platforms—Full-equipped Garage—All Replace Makeshift Construction Outfits Seen on Some Road Jobs

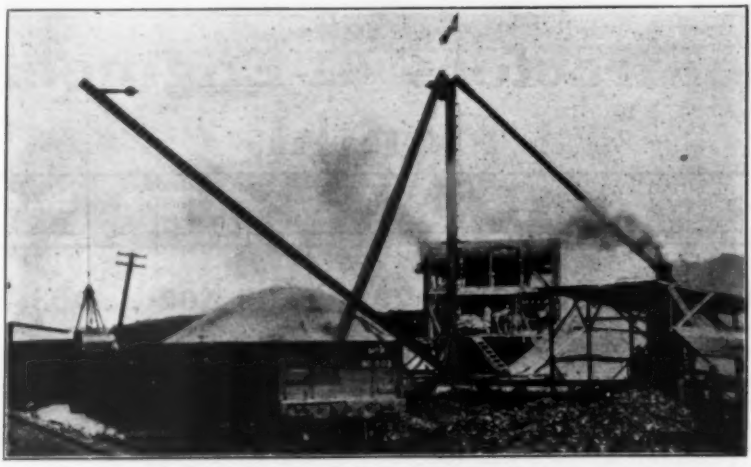
DOES it pay to build a good and substantial concrete road building construction plant? Or is it just as well to buy a bunch of equipment, throw it together as quickly and cheaply as possible, call the job done, and go to building road at the earliest possible minute?

J. W. Horst of the Horst Construction Company tried the first plan up in Cerro Gordo County first. Later, when he got another Iowa contract down in Linn County, he did the same thing. It is not likely that he would have done the same thing over in Linn County if it had not paid him in Cerro Gordo.

The Preparations

Horst got the contract for 5.14 miles of concrete surfacing on the North Iowa Pike in Cerro Gordo County. His mileage reached from Clear Lake to the Hancock County line. That was on March 17, 1920. He picked a construction camp site about midway of his mileage and a short distance from the Milwaukee line. Engineers appeared and laid out a camp site, stakes, spaced and numbered, showed where mixer and material bins were to be erected, the stiff-leg derrick to stand, the cement sheds, the garage and the office to be located, where and how the standard railway track

A GENERAL VIEW OF THE PLANT OF THE HORST CONSTRUCTION COMPANY, NEAR CLEAR LAKE, CERRO GORDO COUNTY, IOWA



STIFF-LEG DERRICK WITH ONE-YARD BUCKET FOR UNLOADING SAND AND GRAVEL FROM RAILWAY CARS

was to be laid from the Milwaukee line to the plant, and where the industrial track for the hauling of the cement from the sheds to the mixer was to ascend its good stiff grade. Then the building crew appeared. It was equipped with saws, hammers, a concreting outfit and a full equipment of building construction tools. Even before frost was out of the ground the crew began work, digging for extensive foundations, and county and commission engineers wondered what Horst was up to.

Of course this was to be a central mixing plant, incidentally the first try-out for that type of concrete road building method in Iowa. Naturally the mixer in such an outfit could be permanently located, but why the concrete foundations? Why the accurate measurements and spacing of different units? Why the flights of wooden steps leading from one elevation to another for the convenience of the workmen? Why the concrete floor where the trucks were to stand while they were receiving their load of mixed concrete? Why the careful draining and graveling of all the space in front of the mixer? Why the careful building of a roadway leading from the mixer to the highway, and why spend company money for gravel surfacing the public highway to the point his trucks passed upon his own job, which stretched for several miles along the north and west shore of the famous Clear Lake? And why, finally, the establishment of an up-to-date garage with a foreman and two helpers and real garage equipment?

The Ways of Working

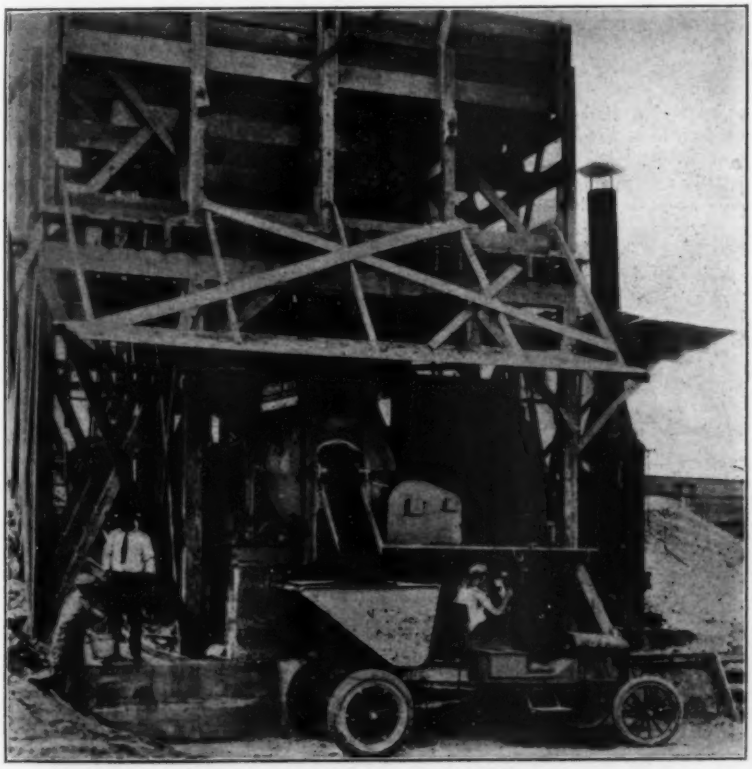
The engineers took these things in and kept quiet at the camp site, but they talked them over among themselves and in the office. They wondered at the plant while it was building, and they had other things different from the ordinary ways in Iowa road building to wonder at while the work was under way. Trucks arrived and departed on the dot. They did not pile up, ten or twelve of them waiting for their loads at the mixer or at the other end for dumping. If one of them came jack-rabbitting in on three legs, it was promptly hauled out of line, whether the driver reported it or not, and a reserve truck took its place. There was no trouble in spotting a crippled truck, for the garage was located so that each truck was required to pass it in circling for its load and hence pass within close sight and ear-shot of the "master mechanic" in the garage, who had full authority to instantly yank a car or a driver out of service.

Work started on the dot in the morning with all hands ready to go. It stopped in the evening when the foreman said stop, just as promptly and decisively, with every man and every tool and piece of equipment in place. If a driver was held up or loitered on the road, there was the reason why to explain when he came in. There wasn't

much loitering, and for the reason that loitering and delay affected the pay-check, or rather the duration of the time of the driver's name on the pay-roll. While right at the first there was some little difficulty in getting a full complement of good men, later in the season there was an abundance of men, and the foreman could pick and choose almost as he wished. As a matter of fact, their entire crew was handpicked and efficient.

Out on the road where the concrete was being deposited there was no backing and twisting and running backwards for long distances with loaded trucks. Instead there was a miniature railroad turntable. The loaded truck headed toward the concrete work ran upon the turntable, two boys put their shoulders against the wheels, and a moment later the truck backed off the table, up to the dumping spot indicated by the crew foreman, a lever was pulled, the load dropped, and the truck darted away again like a scared jack-rabbit, headed straight for the mixing camp.

The Horst job, in the opinion of every engineer, was well organized and well equipped. Work went forward evenly and consistently—not a big run one day and a small one, or none, the next. There were no annoying delays so far as camp equipment or organization was concerned, but there were annoying delays. Every builder had them last season. Sometimes he found it impossible to get materials from the producers. Again, he got the materials but he could not get transportation for them to his job. Occasionally for half a week at a time such conditions prevailed, and so it was on the Clear Lake job. Those are the times that try the contractor's nerve and financial standing. It certainly tries the nerve and patience of a contractor to have equipment and organization capable of doing $3,000 to



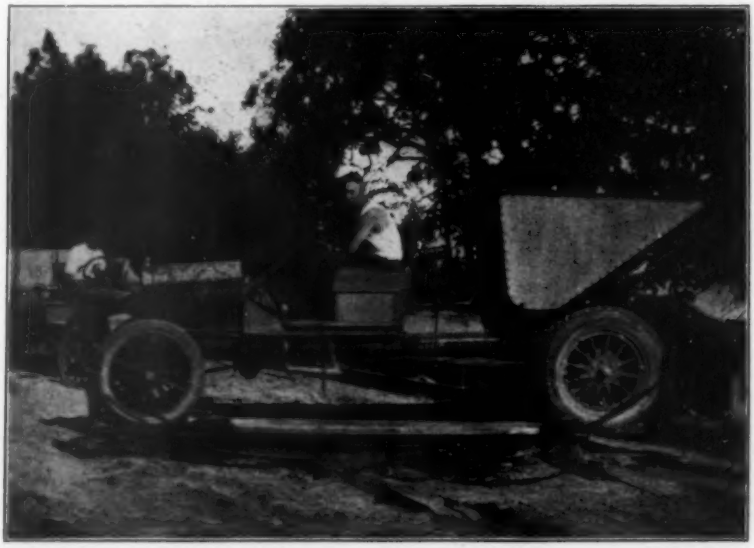
CLOSE-UP OF MIXER AND GRAVEL BIN

$4,000 business per day standing ready to go, without a wheel turning and expenses eating up profit every minute of idleness, and with winter and the season's shut-down twenty-four hours nearer at the close of every day.

Efficiency of the Central Mixing Method

The Horst plant, as stated above, was the first to use the central mixing method on Iowa road work. The longest haul was approximately three miles. It was found that by carefully noting the distance of the haul and the moisture condition of the sand and gravel, and thus varying the amount of water to suit both conditions as well as the atmospheric condition, the wet concrete mix could be delivered on the subgrade at the laying point in even and uniform condition, capable of passing every test and meeting all requirements. There was little or no trouble in avoiding the initial setting of the mixed material before it reached the subgrade ready for placing. The average length of time a load of the mix was on the road on the longest hauls was approximately fifteen minutes. There was a time or two when a load that had been delayed for nearly half an hour after examination, was allowed to be placed, and so far as could be judged finished up as well as the other batches. There were probably not half a dozen loads of mix lost by reason of accident to trucks causing delays.

Considerable difference was noticed in the finishing work with the central mixing product and the mixer on the spot material. During the few minutes of transportation, the central mix material more thoroughly and evenly absorbed the water, and, while the mix appeared somewhat stiffer, there was no noticeable extra difficulty in working and shaping it up with template or tamping device either by hand or the finishing machine. Under the belting there was a little more difficulty because less water worked to the surface under the operation. The surface material was more sticky, and the belt showed a tendency to drag small stone and particles to the surface. Objectionable stones and particles were picked out by the finishing machine operator by hand, and additional belting restored the workability of the surface and removed all traces of holes in the surface. As to the final finished surface, some engineers thought that the central mixing plant material worked up better in the end than the other type; most of them thought the results almost identical, and some thought possibly the mixer on the job produced the best results. Under such slight variation in the



THIS TURNTABLE SAVED MUCH TIME AND TROUBLE FOR THE ONE-TON TRUCKS

opinion of experienced men with no prejudices or selfish interests to bias a judgment, it is likely that the final surface is as good in the one as the other, and that time will show little or no difference in the results under traffic.

The central mixing plant with dump body trucks was well adapted to this special job. There were numerous curves and narrow right of way places, and cuts which would have interfered seriously with an industrial railway equipment, had the central proportioning method and the hauling of the dry mix been adopted. Then too, the grade was along the lake shore, where drainage was good and where there was little difficulty in getting the water of the summer rainstorms quickly off and away from the grade. There were no bad mud-holes for the trucks to navigate, and it was not necessary to plant a road over any bad spots, as happened on several other jobs where trucks were used on the subgrade to haul the materials.

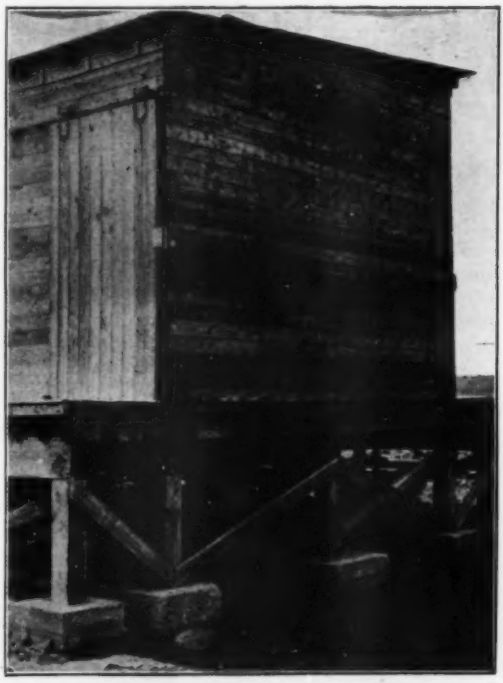
The equipment used on the Horst job consisted of:

15 1-ton Ford trucks with type E. D. Lee line dump bodies.
2 1-ton Ford trucks with general service bodies
1 Lakewood finishing machine
1 Koehring concrete mixer No. 21-G with 12-horse-power engine and 15-horse-power boiler.
1 Buffalo stiff-leg derrick with 1-cubic-yard clam-shell bucket
180 feet 10-foot sections Blaw Knox road forms with pins and wedges
3 5½ Domestic force pumps
11,940 feet of 2-inch black iron pipe with expansion joints for every 1,500 feet, and unions for every 800 feet, and with Ts for every 150 feet
1 auto-truck turntable
1 1,000-foot siding from Milwaukee main line track to construction camp
1 industrial elevated railway track from cement shed to mixer
1 horse for hauling cement

To man the plant

3 men were required, working between the railroad cars and the cement shed and the industrial cars to the mixer station
2 men handled the cement from the industrial cars to the mixer platform
2 men charged the mixer
1 mixer operator
1 derrick operator
1 helper for derrick operator
1 chief mechanic in garage
2 helpers in garage
2 turntable men
3 concrete spreaders
2 men on finishing
2 form setters
4 subgraders
1 team for subgraders
3 men for covering and wetting concrete

The Horst contract covered a mileage of 5.14 miles, comprising 21,060 cubic yards of excavation at $1.31, of a total value of $27,588.60, and 54,435 square yards of concrete surfacing at $3.74 and totalling $203,587.90.



THE CEMENT SHED WAS ON A CONCRETE FOUNDATION AND HAD ROLLER HANGERS FOR THE DOORS

The average daily run, in spite of almost daily shortage of material, was 365 lineal feet per working day, totalling 730 square yards, and worth at the contract price $2,730.20. The maximum daily run was 600 lineal feet of pavement, totalling 1,200 square yards, and worth to the Horst Company $4,488.

Not so bad for a single day's work of 10½ hours. From which it may be deducted that the concrete road building game is one of playing for big stakes. Perhaps this is why the Horst Company finds it advisable to build its construction plants in a good substantial manner, to keep a keen foreman and a good manager on the job, and to maintain a closely fitted-up organization, ready for clean, fast work when time and conditions are right.

ACKNOWLEDGMENT.—Illustrations courtesy of Iowa State Highway Commission *Service Bulletin*.

Standing in One's Own Light

AN item has just come to our attention which is worthy of the consideration of every building contractor. A certain large building under construction was placarded about as follows:

"NOTICE—Keep out unless you've got business. Jones, Brown & Smith, Engineers and Contractors."

The building on which this notice appeared was five stories high on the main street of a modern town. Among the thousands passing it is conceivable that there are a few business men with building problems confronting them, yet the architects, engineers, contractors and others interested in contributing to the completed structure ignored the excellent advertising possibilities of the new building. Under such circumstances it is gross neglect of legitimate opportunity not to take advantage of the conditions thus afforded to give the public interesting, essential, common facts about the work. How much better it would be to have such a building carry a sign something like this while in process of construction:

"This building will contain 100,000 square feet of floor space. It is of fire-proof construction throughout. Four passenger elevators will serve the needs of its occupants. It is being built for Merchant & Co.
The architects, White & Black.
The engineers, Jamestown Engineering Construction Co.
The contractors, Permanent Building Construction Co.

The Selection of Excavation Equipment

A contractor must use his keenest judgment in selecting the proper size of crane and bucket to serve the fleet of trucks on each excavation job

FILLING THE BIG SELDEN TRUCKS IS EASY WITH THE GIANT OHIO CRANE—EACH TRUCK TAKES FIVE YARDS EVERY TRIP

The Economy of Early Contract Awards

By C. D. Franks

District Engineer, Portland Cement Association

CONTRACTS awarded for road and other work during the six months' period ending December, 1920, were influenced in their price by the many handicaps surrounding such work—handicaps such as deliveries of material, leading the contractor to figure on only a percentage of the normal day's output. Labor having been scarce and high in price, this situation was naturally allowed for; the possibility of increased prices had its effect in the contract price. All of these things which would tend to handicap prompt and efficient handling of a particular job were figured in, and liberally so.

Now the contractors can, in general, figure on better railroad service, adequate supply of materials, plenty of labor—more efficient and at lower prices—and a somewhat lower cost of materials. In other words, based on what has happened at recent lettings, the contractor's frame of mind is just the reverse of what it was when he figured work during the latter part of the year 1920. In other words, he is figuring on the breaks' being in his favor rather than against him. It is logical to assume, therefore, that he is going to make a more attractive bid now for work than has prevailed in contracts made within the past six months.

Building conditions now are much the same as when the armistice was signed. Because of the interference previously mentioned, there is a large accumulation of work to be done; yet everybody interested in construction work is adopting a waiting attitude. If this is continued, a turmoil may result similar to that experienced through the last half of 1919 and nearly all of 1920, resulting in nobody's accomplishing what he starts to accomplish in 1921, because of late contract awards, heavy demand all at once for materials, transportation, labor and equipment, all of which will result in higher prices later in the year. In other words, bids submitted now will be more attractive than bids taken during the past season or bids which may be taken when the present general depression is over and business is again upon the upgrade. An increased demand for labor, materials and railroad service will naturally be taken into consideration by the contractor.

A Means of Wise Expenditure of Funds

There is now voted and available for expenditure on road construction alone, many millions of dollars. The expenditure of this money will probably take place during the next five years. Past experiences in the award of public work would indicate that the wisest expenditure of these funds can be effected by having awards made early each year for approximately that amount of work which can be completed in one year by the contractors available. It is reasonable to expect that over a period of five years or more the cost of doing work on such a basis will be as low or lower than will be the cost if an attempt is made to award contracts only when the prices for labor, materials, etc., are at a low point. From our experience of 1919 and 1920, it is evident that when a great deal of work is held up and awards are not made until near the end of the construction season, much of the actual construction goes over until the next season, thus throwing the whole organization out of balance and unduly upsetting the entire program. There is no question but that the difficulties experienced in the road-building industry during 1920 are to a large measure the result of late buying of all commodities in 1919 and late awarding of road and street contracts in 1919. Had much of this work been early in 1919 and completed in that year, it is probable that we should not have had the many difficulties experienced in 1920, in so far as road and street construction are concerned. Then, too, there was much dissatisfaction during the winter of 1919-1920 because of work started on certain sections of road during 1919 which, because of delayed letting, it was not possible to finish during that year. Sections of road left unfinished during the winter and spring of 1920 caused

a great deal of discomfort and loss of money to those required to use such roads.

State Awards Would Overburden the Railroads

Many people are too complacent about the railroad situation. Undoubtedly railroad service has improved greatly through increased efficiency in operation, but the roads are not now called upon to do what they were called upon to do through the last year. Business in general has slowed down and farmers are holding back their products from the market. Business in general is sure sooner or later to revive and the farmer to send his stored products to market. When either or both of these things occur, the railroads will again have more than they are able to do. If everybody wants to do construction work at that time, which means the shipments of materials, the result will naturally be increased contract prices and disappointment because of delays. Now is the time to award contracts for public work. Let the contractor have time to store some material and perfect his organization, and let the material and machinery industries know now what will be expected of them for this year in construction work.

At a time like this when owners, contractors and others may be discouraged from undertaking new projects, the fact should be given prominence that all effort, whether it be in the form of money, credits, materials, labor, transportation, or what not, that goes into construction work, unlike that going into work of many other kinds, is not consumed. Effort expended throughout the country on many things that are consumed might well go into construction work, where the materials and labor an other things involved are not consumed but transformed into houses, industrial buildings, improved highways, water-power development, and other valuable improvements that form additions to the permanent, taxable wealth of the country as well as tools for the production of additional wealth.

If construction work is needed and if such work will add to the permanent wealth of the individual and the country at large, it should be carried on when not subjected to interferences that have been present almost continuously since our entry into the war and which may again be present later. There is now and will be plenty of cement to supply the country's needs as long as transportation and other conditions permit cement mills to operate reasonably near full capacity and to ship the finished product.

"Economy" is the watchword, but all are aware that there is a shortage of houses. Rents will remain high until there are enough houses to supply the demand. Houses are not the only things needed; construction work of other kinds must go ahead, notably highway and railroad improvements. Economy in construction means early contract awards and more business for the contractor.

THE TRUCK IS REPLACING THE HORSE IN EXCAVATION WORK

Simple Handling of Bulk Cement Works Out Well for Road

Absence of Special Plant or Equipment, the Outstanding Feature of Plant Layout at Townsend, Del.

By Arthur Loeb

Vice-President, Keystone State Construction Company, Philadelphia, Pa.

IT is often considered that when bulk cement is used in place of bagged cement, a handling plant must be especially designed with special equipment installed. In the material plant for our concrete road work at Townsend, Del., we provided very simple methods with no special equipment. If necessary, a few changes would enable us to handle bagged cement. We have found, however, that using bulk cement is no more trouble than using bagged cement when the counting, bundling and shipping of empty bags are considered.

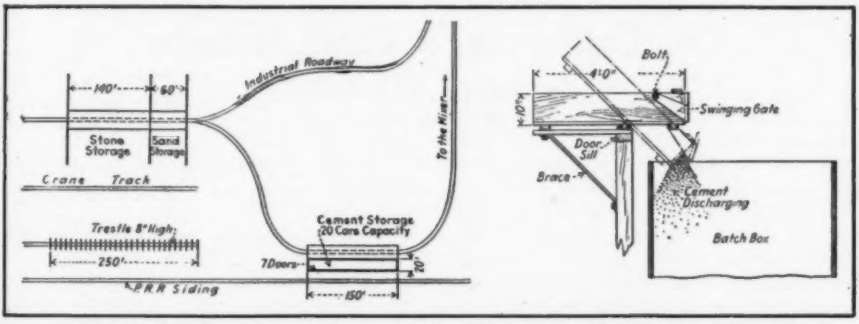
The cement storage house is 150 feet long by 20 feet wide, with a capacity of 20 cars, or over 4,000 barrels of cement. It is very substantially built in order to prevent the possibility of moisture or dampness entering. It has a concrete foundation and a concrete floor at ground level. As shown in the layout, the railroad siding is located along one side and the narrow-gage industrial track at the other.

The doors at the railroad side are so located that the cement can be discharged through a chute from the car directly into the house. The upper end of the wooden chute is flared, with a cloth nailed over the top to prevent excessive dusting; and is located about breast high so that the cement can be easily shoveled into it.

When unloading the car, two men are used, shoveling the cement in the center of the car directly into the chute. As soon as the unloading progresses to a point where it is inconvenient to shovel into the chute, it is removed and the cement at the ends of the car is wheeled into the house in wheelbarrows. Horizontal stringers nailed to the studs and center posts at door level support the wheeling runway, which can be shifted at will. When the house is filled to capacity, the cement lies level with the door-sills at each side of the house.

The cement upon being discharged from the chute is remarkably "lively," and flows to the far side of the building almost like water. For measuring the cement into the batch boxes, a very simple method was devised, and it has worked out well.

The doors of the cement house are so located as to be at the proper spacing for the batch boxes on industrial cars. The sills of the doors are located 7 feet above track level, and on each sill are two tilting boxes, each of the right size to hold 4 cubic feet of cement—the proper amount for the 4-bag batch used.



PLAN FOR PLANT LAYOUT AND DETAIL OF MEASURING BOX FOR BULK CEMENT

The tilting measuring boxes are filled by means of hand-pails—an easy operation, because the loose cement can be easily scooped up by the pail. As the level of cement becomes too low for one man to fill the box conveniently, an additional man is stationed below to fill and hand up the pail to the man above. The boxes are filled and ready for the trail of industrial cars when it arrives and is spotted in the proper position. A slight pull tilts the box and discharges its contents through the automatic lift gate located at the outer end of the box, as shown in the detail drawing.

It would have been desirable to place the industrial tracks in a depression below ground. The high ground water level prevented doing this conveniently. If the tracks had been lowered, the tilting boxes also could have been located lower, thus eliminating the necessity for passing up the cement.

As soon as the gasoline locomotive spots the cars at the cement house, it takes a string of loaded cars from the aggregate tunnels to the mixer, at present writing about 1½ miles away. This distance is lengthening and at the completion of the work will be about 6 miles maximum.

A locomotive crane transfers the material to the storage piles over the tunnels, from which it is drawn by means of steel gates into the batch boxes. The cars carrying the steel batch boxes are pulled from the cement house to the aggregate tunnels by a mule, and occasionally are pushed by the men. This allows the gasoline locomotives to be used exclusively for the long haul to the mixer and thus eliminate delays. The cement and aggregate plant has sufficient capacity to keep three gasoline locomotives busy and the mixer is never idle waiting for the material.

ACKNOWLEDGMENT.—From the *Contractor's Atlas.*

The Contractor's Chief Menace

By Samuel G. Kuhlen
Austin Machinery Corporation

CONTRACTORS are not immune from the one bane common to all industries, that of "leaks" through misuse and waste of time and energy Masters of efficiency have not yet succeeded in completely eradicating this drain on profits from any line of business, and there are few lines which offer so many obstacles to thoroughgoing efficiency as contracting.

Since labor is, perhaps, the contractor's largest single cost item, great care should be used in its conservation. As a general rule, however, it receives scant attention. Many men are still employed for work which can be much more economically handled by machinery.

Paving, for instance, affords striking examples of inconsistency. Few contractors would even think of mixing concrete by hand. No, indeed, nothing short of the largest and fastest machines would answer for this important duty, or how could bids be figured to win? Yet the majority of contractors still use hand labor for all the remaining operations, in spite of the fact that perfected machinery is now available which tamps, strikes off and finishes, combining these three operations in one and doing it as fast as the mixer can lay down the batches.

Idle paving machines are another serious drain on profits. Large amounts are often lost on one contract by keeping fast machines of generous capacity, together with their crews, waiting for batch materials. This can be avoided by the use of narrow-gage gasoline locomotives and batch cars.

Equally wasteful is the widespread practice of filling ditches by hand instead of using a backfiller.

Many contracts fail to return proportionate profits because of worn-out or antiquated equipment. The temptation to squeeze the last dollar out of an investment is quite natural, but the time inevitably comes when excessive repairs or capacity limitations spell the doom of this class of inefficiency. The poorly equipped contractor cannot hope to compete successfully with his more progressive rival. If he figures to make a profit on his costly methods he is sure to lose contracts, and if he figures to win contracts he will as surely forfeit his earnings in their execution.

Cost Keeping on Construction Work

By F. H. Austin

Currie Engineering Company, Webster City, Iowa

GOOD engineering requires that designs not only insure that structures will fill the purpose for which they were intended, but that the design finally decided upon will be the most economical one. The estimating ability of the engineer is often the deciding factor between two designs. The subject of cost keeping on construction work is one in which every engineer must be vitally interested, and one which presents many difficulties to be overcome.

Of what real value to the engineer is a knowledge of the cost of construction? What trouble and expense is he justified in taking to obtain this information?

Possibly the greatest value of cost data is its aid in preparing an estimate of cost. Some engineers argue that by closely following lettings, and observing the bids received, they are able to make estimates that will come close to the low bid. They also claim that there is usually some bidder who is governed to a large extent by the engineer's estimate, and that consequently the estimate, even though inaccurate, will not be far from some of the bids.

The object of an engineer's estimate of cost should not necessarily be to approximate the low bid, but rather to be of such amount as to allow a responsible and informed contractor to fulfil the terms of the contract, and with a fair margin of profit. If an engineer's estimate of cost is based on accurate cost data of such value that an individual cost datum, which may be somewhat in error, will not materially affect the total, will he not have more confidence in his estimate, and, consequently, will not the estimate be of vastly more value to his client?

Some Examples

Take, for example, the case of a town council receiving bids on a sewerage system. Suppose the council has asked for an estimate of cost and the low bid is some 15 to 20 per cent above the estimate. Is it not one of the most valuable items of engineering service to the town for the engineer to be able to say with conviction that the bids are too high and that the town can save money by having another letting? Or, suppose the low bid is considerably below the estimate. Is it not the engineer's duty to himself, the bidder, and the town to advise the council that the work cannot be constructed for the amount bid, that the contractor will lose money or throw up the job to his bondsman, with the subsequent trouble and delay, and that the town is very apt to get an inferior piece of work? True it is that an engineer often does give this advice, but it is often with some misgivings and the fear that his estimate has been made on none too sound data and formulæ.

Another item of the value of cost data is in the comparison of different designs. The writer recalls an instance of this in one of his own designs for a tile outlet of a large drainage district. The design was completed —sizes, lengths, and depths—and he was well satisfied with the design in general. There was being used some 2½ miles of pipe ranging in size from 30 to 39 inches at a depth of from 8 to 14 feet. About one-half mile from the lower end there was a portion of the line which had considerable fall. By starting a new grade line from the upper end and using steeper grades and smaller sizes, it was possible to save some 6 to 8 thousand dollars, although the average and maximum depths were considerably greater; at least, the two estimates of costs so indicated.

Another instance of this kind occurred in the design of a sewerage system for a town of about 1,500 population. The slope of the town was such that the obvious thing to do was to carry the entire town north and east to a small creek. The design was so worked out, pumping the southwestern part of the town, which lay in a hollow. Later on, a possible gravity outlet for this part of the town was investigated, and, while it was apparently not feasible, the comparison of cost estimates favored the gravity outlet by some 10 to 12 thousand dollars.

In such cases as these—and they are encountered every day in designing—the ability of the engineer in comparing the relative costs of different designs is certainly invaluable to his client.

The Division of Cost Data

The cost data necessary for careful estimating may be classified in four divisions: materials, labor, overhead, and local conditions.

Take, for example, the cost of a sewage treatment plant. The cost of materials will include the cost of concrete materials, form lumber, sheeting, bracing, reinforcing brick, filter sand and stone, sewer pipe, cast iron pipe, valves, pumps, siphons, doors and windows, and a great number of odds and ends of different kinds of materials. It is relatively easy to obtain reliable cost data on most of these items, and a careful estimate should take into account most of the items separately, although some of them could be grouped. This information can be obtained from the manufacturers, or from the contractors, who would probably show their bills for materials if the proposition was put to them in the proper light. Freight and shrinkage, of course, should be taken into account in arriving at the cost of materials.

The cost of labor will include the cost of excavation, forming, mixing and pouring concrete, placing reinforcing, removing forms, laying brick-work, setting doors and windows, cast iron pipe, valves, pumps, forming embankments, seeding, sodding, placing sand and stone, laying pipe, hauling, etc. It is evident that it would be almost impossible, and certainly not feasible, to arrive at cost data on all these different items, and some of them must be grouped.

It is essential to obtain the items of labor cost in terms of man-hours, differentiating between skilled and common labor, machine-hours, and ton-mile haulage, in place of obtaining the information in terms of money, as has often been done.

The cost of overhead is perhaps more difficult to determine, and will contain such items as office expense, superintendence, depreciation on machinery and equipment, repairs, losses of small equipment, such as tools, jacks, cement sacks, etc., bonds, interest on investment and borrowed capital, insurance of different kinds, discounts on bonds, cleaning up, moving, and many items of general expense connected with the contracting business.

This cost can probably be best ascertained by making friends with the contractor and assuring him that the individual information will not become public property. Most of the reliable contractors will probably see the advantage of contributing cost information, in that the chance of their being able to obtain work at a fair price so often depends on a fair estimate of cost by the engineer.

The local conditions that will affect the cost of construction will include: site condition; proximity of work to suitable materials; class of local labor and teams available; local housing and boarding conditions; forms of amusements and entertainments tending to keep labor contented.

If we should analyze the factors of cost on some other class of work we might find that some of the individual items of cost would be considerably different.

The matter of efficient handling of the work and whether or not the contractor has time- and labor-saving equipment should be noted and recorded in any method of cost keeping that is to be of value.

I wish to give as an example an actual comparison between the cost of a sewer job as determined by cost-keeping reports to the engineer, and the cost as determined by the contractor's cost records:

	Engineer	Contractor
Materials	$ 7,625.55	$ 9,770.19
Labor	9,574.50	9,835.51
Use of machines	6,500.00	6,254.90
Overhead	5,119.21	5,570.32
Total	$28,819.26	$31,439.92

In the foregoing comparison the engineer's costs were made as follows: materials, from unit prices as quoted at the time of letting; labor, from the cost reports as returned by the resident engineer, using the actual rates of pay; overhead, calculated as a percentage of the materials and labor costs, using a percentage based on the contractor's figures, which in this case amounted to about 21.6 per cent. In this particular instance the contractor rented the machines, and the per diem charges for these machines were used in determining the amount for the use of machines under the engineer's cost.

These figures indicate that the engineer's cost fell short of the contractor's cost by about 9 per cent. The greater part of this difference was in the item of materials, and it is evident that in this particular instance more care should have been taken in ascertaining the amounts of the different materials used.

CURRENT CATALOGS

The catalogs and pamphlets listed below are available for free distribution. Contractors and Engineers who check over these pages each month and write for such material as interests them, will find this a valuable means of keeping up to date on the subject of machinery and equipment.

EVERYTHING FOR THE ROAD MAKER.
The general catalog of the Good Roads Machinery Co., Inc., 821 Bulletin Bldg., Philadelphia, Pa., describes in detail its complete line of road graders, scarifiers, wheeled scrapers, plows, rock crushing and screening machinery, road rollers, oiling machinery, concrete mixers, etc.

WATER METERS WITH UNBREAKABLE DISCS.
Lambert water meters made in sizes from ⅝ to 6 inches are described in the illustrated booklet of the Thomson Meter Co., 100-110 Bridge St., Brooklyn, N. Y.

HYDRANTS—PUMPS—VALVES.
R. D. Wood & Co., Philadelphia, Pa., engineers, iron founders and machinists, will be glad to furnish information to contractors and engineers on pipes, hydrants, valves, gas-producers, pumps, gas works materials, etc.

AN EFFECTIVE ROAD PLANER.
Bulletin C, published by the Kinney Mfg. Co., 3529 Washington Street, Boston, Mass., describes in detail the Kinney road planer, a new machine which after a thorough try-out has been accepted by contractors and engineers as one of the necessary adjuncts of the road contractor's equipment.

LONG-LIVED CONCRETE MIXERS.
Bulletin 104 gives you complete information regarding long-lived Ransome concrete mixers, many of which have been in service for over 17 years. A copy of this bulletin may be secured by writing to the Ransome Concrete Machinery Co., 1772 Second Street, Dunellen, N. J.

REBUILT AND USED MACHINERY FOR CONTRACTORS.
The Titan Equipment Co., 30 Church St., New York City, has an extensive list of rebuilt and used equipment for contractors, which it will be glad to forward to any interested parties on request.

CONCRETE MIXERS FOR CULVERT AND ROAD WORK.
The Giant mixer especially adapted to concrete culvert and road work, which may be purchased on the part payment plan, is described in the literature of the Judy Mfg. Co., Centerville, Ia.

ROAD SIGNS.
An interesting booklet, "Signs of Progress," may be secured from Department B, Lyle Culvert and Road Equipment Co., Minneapolis, Minn., by any contractors or interested road engineers.

MANHOLE, CATCH-BASIN AND SEWERAGE CASTINGS.
Prices and descriptive literature covering manholes, catch-basins and sewerage castings may be secured from Wm. E. Dee Co., 30 North La Salle St., Chicago, Ill.

HAULING DATA FOR CONTRACTORS.
In an interesting booklet bearing the title "Contract Hauling with White Trucks," the White Co., Cleveland, Ohio, has furnished a great deal of information with illustrations on all kinds of hauling for contractors.

EXPLOSIVES FOR CONTRACTORS.
Descriptive booklets and price lists of Du Pont explosives for all purposes may be secured from the Sales Department, Explosives Division, E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del.

CLAM-SHELL BUCKETS FOR SPEEDY WORK.
Complete data regarding the Owen Type "O" clam-shell buckets for handling crushed stone and other building materials from cars, are included in the Speed Bucket catalog of the Owen Bucket Co., 418 Kirby Bldg., Cleveland, O.

BUILDING CONCRETE FLOORS.
The Corrugated Bar Co., Buffalo, N. Y., in its 64-page booklet describes flat slab or two-way system Coor-Plate floors for factory, stores, warehouses or industrial buildings.

PNEUMATIC ROCK DRILLS.
The Cleveland "Pocket in Head" rotators, which have particularly economical features and are extensively used in rock drilling, may be secured from the Cleveland Rock Drill Co., 3734 East 78th St., Cleveland, Ohio.

UNBREAKABLE CAST IRON MANHOLE COVERS.
The most recent development in serviceable, nonbreakable cast iron manhole covers is described in the latest bulletin of the Central Foundry Co., 90 West St., New York City.

CONTRACTING AND ENGINEERING COMPUTATIONS.
The use of the calculating machine in all kinds of contracting computation and pay-roll work, as well as for engineering design, is described in the literature of the Monroe Calculating Machine Co., Woolworth Bldg., New York City.

PAVERS FOR ALL SERVICES.
Catalog HD, published by the Koehring Machine Co., Milwaukee, Wis., tells of the use of Koehring concrete mixers for road and building jobs in sizes from 4 to 28 cubic feet of mixed concrete to a batch.

INDUSTRIAL LOCOMOTIVES.
A catalog describing Porter industrial locomotives for road or yard work is awaiting your request to the H. K. Porter Co., Pittsburgh, Pa.

BETTER ROAD BUILDING WITH TRACTORS.
In an illustrated booklet, which is available to contractors on request, the Cleveland Tractor Co., 19211 Euclid Ave., Cleveland, O., describes the use of the Cletrac for road building, whether excavating, grading or hauling.

SEWER PIPE, DRAIN TILE, PAVING BRICK, ETC.
Full prices and information regarding all kinds of products made from clay for contractors' needs may be secured from the Delaware Clay Products Co., 612 Arrott Bldg., Pittsburgh, Pa.

DATA ON SECOND-HAND EQUIPMENT.
Lists of used equipment and second-hand machinery may be secured from the Searchlight Dept., The McGraw-Hill Co., 475 Tenth Ave., New York City.

A LIGHT TRUCK FOR CONTRACTORS.
The GMC 1-yard truck is described in a folder of particular interest to contractors, which may be secured from the General Motors Truck Co., Pontiac, Mich.

TRENCH EXCAVATING MACHINERY.
In catalog A-118 the Austin Machinery Corporation, 609 Railway Exchange Bldg., Chicago, Ill., has included valuable data and instructions to contractors.

ROAD BUILDING BY TRACTOR.
That the tractor is fast taking the place of animal power in road building and road maintenance work is granted by most contractors and engineers. The work of Best track-layer tractors is described in a folder entitled "Road Building the Best Way," which may be secured from the C. L. Best Tractor Co., San Leandro, Cal.

AERIAL TRAMWAYS.
Aerial wire rope tramways for all kinds of construction work are described in a 40-page illustrated booklet which may be secured by contractors from the Broderick & Bascom Rope Co., St. Louis, Mo.

DRINKING FOUNTAINS WITH COOLERS.
Catalog C, a 74-page drinking-fountain booklet published by Rundle-Spence Mfg. Co., contains details of the Vertico-Slant drinking-fountain, which can be readily equipped with cooler attachment for summer service.

CENTRIFUGAL PUMPS THAT ARE EASY TO INSPECT.
Bulletin B-40, issued by the De Laval Steam Turbine Co., Trenton, N. J., contains the details of the horizontally-split casing which makes large and small size De Laval pumps easy to inspect without disturbing pipe connections.

GENERAL CATALOG OF ROAD MACHINERY.
The general catalog of the Acme Road Machinery Co., Frankfort, N. Y., contains illustrations and short descriptions of its graders, crushers, dump-wagons, elevators, road rollers, pressure distributors and conveyors. Another feature of this catalog is the cross-section paper for estimating and forms for making abstracts of bids.

SELF-DIGGING WAGON LOADERS.
Wagon loaders that crowd themselves into the pile and make every bucket a full one are described in Bulletin 820, which may be secured from the George Haiss Mfg. Co., 142nd St. and Park Ave., New York City.

CONCRETE MIXERS FOR ALL SERVICES.
F. H. Conklin & W. G. Harrington, Room 1762, 50 Church Street, New York City, sell "Wonder" concrete mixers, described in their printed matter, which is sent on request.

MECHANICALLY CORRECT CONCRETE MIXERS.
Keystone power-loading, low-charging concrete mixers with automatic water-measuring tanks, which are mechanically correct in construction and scientific in operation, are described in a folder which may be secured from the Gray Iron Foundry Co., Reading, Pa.

QUARRY CARS FOR CEMENT, SAND AND STONE.
The Koppel Industrial Car & Equipment Company, Koppel, Pa., in Bulletin 36 describes and illustrates its all-steel side- or end-dump body cars for general use on industrial railways for road work and general excavation.

PUMPING SYSTEMS FOR DEEP WELLS.
Complete information regarding air lift pumping for deep wells is included in a booklet bearing the above title, which may be secured from the Indiana Air Pump Co., Pythian Bldg., Indianapolis, Ind.

HAND BOOK OF HOLLOW TILE CONSTRUCTION.
The Hollow Building Tile Association, Conway Bldg., Chicago, Ill., will send to any interested contractor or engineer copies of the various Hollow Tile handbooks on building construction upon receipt of requests.

STEEL FORMS FOR CONCRETE ROADS AND SIDEWALKS.
The use of Heltzel steel forms on road jobs to speed up construction is told in an interesting manner in the latest illustrated literature of the Heltzel Steel Form and Iron Co., Warren, Ohio.

BODIES FOR CONTRACTORS' TRUCKS.
The complete line of bodies manufactured for contractors by the Heil Co., 1243 26th Avenue, Milwaukee, Wis., is described in catalog 113, which is yours on request.

ROAD ROLLERS.
Complete information regarding all types and sizes of steam and motor rollers with scarifier attachments may be secured by writing to the Buffalo-Springfield Roller Co., Springfield, Ohio, and asking for a copy of catalog A.

PUMPS FOR FIRE SERVICE OR WATER-SUPPLY.
Northern rotary pumps, which are claimed to deliver more gallons per minute per horse-power than any other pump, are described in the new catalog of the Northern Fire Apparatus Co., Minneapolis, Minn.

ROAD-MAKING MACHINERY.
Catalog 21 issued by Stroad & Company, Omaha, Nebr., contains 32 pages of illustrated descriptions and details regarding the various types of road construction machinery manufactured by this company.

LOCOMOTIVE CRANES.
The Brown Hoisting Machinery Co., Cleveland, O., describes in its catalog CK-1921 the many uses and features of Brown hoist cranes.

KNOW WHAT YOUR PUMP DELIVERS.
In order to be sure whether water-works pumps deliver the proper amount of water and where it goes in the system, you should check up your pumpage with the Simplex Pitot Recorder, described in a bulletin which may be secured from the Simplex Valve and Meter Co., 5722 Race St., Philadelphia.

ROOFING BOOK FOR CONTRACTORS.
Complete information regarding the best type of flashing for different kinds of roofs is included in a 48-page booklet entitled "Roof Flashing Hand Book," which may be secured from the Barrett Co., 17 Battery Pl., New York City.

GRAVEL AND STONE SCREENS AND BINS.
Bulletin 105 M, which may be secured from C. H. Connell, Weller Manufacturing Co., Chicago, Ill., describes in detail the features of Weller screens and storage plants built specially for contractors.

BUCKETS BUILT TO DIG.
Interesting details regarding Williams' clam-shell buckets for handling coal, ore, sand, gravel, crushed stone and bulk material of this character, are included in illustrated folders, which may be secured from the G. H. Williams Co., Erie, Pa.

HOW TO BUILD ASPHALT MACADAM ROADS.
A booklet telling how to build asphalt macadam roads, describing the process from foundation to finished roads, step by step, and illustrated with cross-sections and photographs, has been issued by The Texas Co., Asphalt Sales Dept., 17 Battery Pl., New York City.

SEWER CLEANING EQUIPMENT.
All parties interested in the quick and thorough cleaning of sewers should secure a copy of the 1921 Bulletin of the Turbine Sewer Machine Co., 195 Eleventh St., Milwaukee, Wis.

A JACK FOR EVERY NEED.
The catalog recently issued by the Duff Manufacturing Co., 530 Preble Ave., Pittsburgh, Pa., contains data and illustrations of every type of jack from the small Duff motor truck jack to powerful 75-ton locomotive jacks.

GOOD ROOF GUIDE BOOK.
Contractors interested in obtaining data regarding types of roofing should secure a copy of the Good Roof Guide Book from the Barber Asphalt Paving Co., Land Title Bldg., Philadelphia, Pa.

RUST-RESISTING CULVERTS.
Interesting tests of genuine open-hearth iron rust-resisting culverts, as well as the service of these culverts in use, are described in a catalog which may be secured from the Newport Culvert Co., 551 West 10th St., Newport, Ky.

ROAD PLOWS, STONE UNLOADERS, CULVERTS.
Catalog F, published by the Burch Plow Works Co., Dept. K-2, Crestline, O., gives in considerable detail descriptions of the Burch line of machinery, including road plows, rooter plows, stone unloaders, stone spreaders and culvert pipe.

STEEL TANKS FOR WATER-SUPPLY.
Full data regarding sizes, elevations and uses of elevated steel tanks for water-supply will be found in the literature of the Pittsburgh-Des Moines Steel Co., 834 Curry Bldg., Pittsburgh, Pa.

STEAM AND ELECTRIC SHOVELS—DREDGES—EXCAVATORS.
Catalog No. 19 A, issued by the Bucyrus Co., contains brief descriptions of its steam and electric shovels, dipping dredges, placer dredges, hydraulic dredges, dragline excavators, tower excavators for levee building, trench excavators, railway wrecking cranes, spreader plows and unloading plows, as well as photographs showing this machinery in action.

CONTRACTORS', ENGINEERS' AND MANUFACTURERS' NOTES

New National Steel Fabric Office

Owing to the continued expansion of the activities of the National Steel Fabric Company, 909 First National Bank Building, Pittsburgh, Pa., this company has announced the opening of a sales office in the Mutual Building, Kansas City, Mo., in charge of H. H. Robinson.

Buffalo-Springfield Opens Chicago Office

The Buffalo-Springfield Roller Company, Springfield, Ohio, manufacturers of Kelly-Springfield and Buffalo-Pitts road rollers, both steam and gasoline, have opened offices in Chicago, Ill., with E. H. Edwards in charge. The office is located at 975 Old Colony Building, Van Buren and Dearborn Streets.

C. B. Smith Leaves A. A. E.

C. B. Smith, known to most engineers as editor and manager of *The Professional Engineer*, the organ of the American Association of Engineers, has resigned to accept a position with the Chicago Bridge and Iron Works, Chicago, Ill.

Hand With Truscon Steel

The Truscon Steel Company, Detroit, Mich. and Youngstown, Ohio, has announced that Morgan Hand, Jr., has become special representative of that company on road and highway work, with headquarters in Philadelphia, for the states of New York, Pennsylvania and New Jersey.

Adamson Increases Product

The Adamson Manufacturing Company, East Palestine, Ohio, has added a new department for the manufacture of all kinds of storage, pneumatic and pressure tanks, welded pipe, battery casings, evaporators, condensers, and a large line of arc-welded products adaptable to the requirements of the contracting and building industries.

A Change in Troy Wagon's Personnel

The Troy Wagon Works Company, Troy, Ohio, has announced the resignation of G. R. Harris, formerly Secretary-Treasurer, and the appointment of W. J. Murray as General Manager and H. H. Tamplin as Secretary-Treasurer.

King Starts Equipment Business

Philip T. King has recently announced his resignation from the Titan Equipment Company, New York City, and that he has gone into business for himself in the sale of used equipment, at 30 Church Street, New York City.

Increase in Use of Lee Bodies

According to the *Excavating Engineer*, last year's construction work proved to such an extraordinary degree the success of the bodies manufactured by the Lee Trailer & Body Company, 2343 South La Salle Street, Chicago, Ill., for use on light trucks, not only for concrete road construction but in connection with excavation work under steam shovels, that a large number of truck manufacturers are at the present time building special chassis to take Lee single-hopper and dual-hopper automatic end-dump bodies. These manufacturers have taken cognizance of the fact that such an application opens up a big field for sales of light trucks.

With the exception of the Ford and the Autocar, most trucks have too long a loading space back of the cab to mount satisfactorily a dump body of this type. Consequently, the greater number of the thousand or so bodies sold to consumers last season were on these makes of trucks. During this winter, however, the following companies have brought out experimental short-wheel based models for this purpose: Kissel, Velie, Federal, Packard, GMC, Diamond T, Garford, White and Indiana. Most of these companies are using their 2- or 2½-ton models as a basis, consequently the majority will be equipped with the dual-hopper Lee automatic end-dump bodies, each hopper carrying either ¾, 1 or 1¼ yards of material.

Hoeltge Returns to Central Foundry

Henry Hoeltge, until recently Western Advertising Manager for the *Plumbers' Trade Journal*, has been appointed advertising manager for the Central Foundry Company, 90 West Street, New York. Mr. Hoeltge was with the Central Foundry for a number of years prior to entering the United States Army in 1917.

A New Truck Tire Tread

Much scientific and technical interest is being centered in the "Cross and Square" tread tire developed recently by engineers of the Firestone Tire & Rubber Company, of Akron, Ohio. The tread is somewhat of a departure from all the old ideas in tread designing. It was in the process of development many months before actual production was begun in the Firestone factory.

The Cross and Square is said to be a highly developed combination of all the advantages contained in the former tread types. It is stated that all the minor disadvantages heretofore encountered in tire building have been practically overcome in its building.

Contractors Speed Up Road Building With Truck, Steam Shovel and Machinery

A FLEET OF 5-TON ACME TRUCKS EQUIPPED WITH BURCH STONE SPREADERS, USED ON ROAD WORK BY J. L. SEEDS & COMPANY, CONTRACTORS, NEAR MARION, OHIO

How to Resurface Worn Brick Pavements

1, Remove all crumpled and broken brick and clean out the holes; 2, thoroughly clean the old brick surface by either sweeping or flushing, or by both sweeping and flushing; 3, fill all holes and depressions of the old brick surface with asphaltic concrete binder; 4, lay a close binder of asphaltic concrete so as to bring the street to an even contour and thereby allow a uniform wearing surface to be laid; 5, lay a wearing course of either asphaltic concrete or sheet asphalt. This course is usually two inches in thickness.

A MARION STEAM SHOVEL LOADING KOPPEL DOUBLE SIDE-DUMP INDUSTRIAL RAILWAY CARS

PART OF THE FLEET OF FEDERAL TRUCKS WHICH MADE THE DIRT FLY WHEN ANDOVER, MASS., ACQUIRED A NEW STREET

Have you secured your copy of the National Standard Truck Cost System? If not, write to the CONTRACTORS' AND ENGINEERS' MONTHLY, 154 Nassau Street, New York City, at once for a free copy.

A 3½-TON SERVICE TRUCK RECEIVING ITS LOAD AT ASPHALT PLANT, WABASH, IND.

The Road Roller Derby

Unique Contest Staged During Annual Convention of American Road Builders' Association at Chicago

A UNIQUE contest was staged at the Chicago Good Roads Show during the week of February 7. While a mid-winter road show prevents an actual road-building demonstration in a northern clime, it did not prevent giving a good display of mechanical power and showing off the road rollers in action. At 155th Street on the south side of Chicago, in the suburban city of Harvey a road roller race was conducted, open to steam and motor-driven road rollers of all kinds. The contest for road rollers consisted of three items, a race for motor road rollers, a race for steam rollers, and a tug of war between the winning steam roller and the winning motor roller to determine the pulling power of each. This was followed by a display of motor-driven street cleaning equipment showing a machine that sprinkles, sweeps and picks up the dirt from the street in one operation.

The course for the road race of the rollers was a triangular one around three blocks. The motor road rollers proved superior to the steam rollers regarding speed and horse-power. The winning motor roller did the course in 3 minutes and 55 seconds, while the winning steam roller took 4 minutes and 25 seconds. In the tug of war, which was conducted on a sanded area of the street so as to give the wheels a fair grip, the engines exerted enormous power and during the contest broke the chain with which they were hitched together, the links being made of ¾-inch round steel. The steam roller pulled well while the pressure of steam was at its maximum, but after a few minutes of struggle the loss of pressure showed very apparently, and in the final tussle after the chain had been replaced, the 10-ton motor roller with a single-cylinder engine of 12-inch diameter by 18-inch stroke walked away with the steam-driven machine with safety valves set for 150 pounds pressure, the steam engine being double-cylinder type, and the cylinders 5¾ inches diameter by 9-inch stroke.

THE STEAM ROLLERS STARTING THEIR RACE, WITH THE MOTOR ROLLERS WAITING THEIR TURN IN THE BACKGROUND

The illustration herewith shows the steam roller race under way and the motor rollers waiting their turn in the background. The program was in charge of the Publicity Manager of the Road Show and N. De Wind of Chicago. The starter was the Hon. Matt Stobbs, Mayor of Harvey, Ill., and the judge was H. R. Kasson of the R. F. Conway Company, Chicago, assisted by H. A. Gray, a delegate from Malone, N. Y., and J. A. Hall, a newspaper editor of Harvey, Ill, all of whom served creditably.

Purchase and Erection of Engineering Equipment

Part I

A. S. Loizeaux

Electrical Engineer, Consolidated Gas, Electric Light and Power Company, Baltimore

IN the purchase and erection of engineering equipment certain well-defined steps are generally necessary, which may be outlined as follows:

1. Determination of work to be done by the equipment
2. Choice of general character of equipment to do the required work
3. Specifications to cover construction and performance of the various parts of the structure and equipment
4. Contracts to cover price, terms of payment, time and point of delivery, erection and initial operation
5. Following up manufacture, delivery and erection, inspection of material and equipment and necessary testing to insure that all terms of contract are fulfilled

The above five items cover in general the work of the engineer in charge, and will vary materially with the variety of equipment met with in practical work.

The engineer's object in choosing methods and equipment to accomplish desired results should be to get maximum reliability and efficiency with an ultimate minimum cost for fixed charges and operation. This object can generally be achieved by the employment of the best equipment obtainable, of ample capacity and simple and rugged construction. This kind of installation will not be the cheapest to buy or install, but will figure the cheapest in total costs over a period of years of operation. The engineer should realize that the final judgment of his work is not a theoretical or technical matter. His work will be judged by the same hard, practical tests that all other work is judged by. Does it work? Does it pay? Does it stand the test of time?

To illustrate in a practical way the steps mentioned in the purchase and erection of engineering equipment, we will take the problem of unloading coal from barges at a water-front and transferring this coal to the bunkers of a boiler-house about 300 feet distant from the water-front and 70 feet above the water.

Determination of Work to Be Done by the Equipment

The engineer's first step is the determination of work to be done by the equipment.

The power-plant design in the case which we have taken as an example contemplated an ultimate development calling for a maximum power-house output of about 120,000 kw. If 2.5 pounds of coal are burned per kw. hr., this output would require a maximum use of coal of 300,000 pounds per hour, or 150 short tons per hour. A load factor of 80 per cent would indicate a maximum requirement of 2,880 tons per 24-hour day. It is, of course, desirable to unload coal in daylight in a working day of 8 hours, making the capacity of coaling equipment large enough to supply maximum ultimate coal in an 8-hour working day. This condition to supply 2,880 tons per day of 8 hours would require an outfit of 360 tons capacity per hour, *i. e.* 8 x 360 = 2,880.

It is evident that there is much latitude allowed to the judgment of the engineer in the determination of the first point, that is, the capacity that he shall require of the equipment. One device working 8 hours for maximum coaling must be 360 tons per hour capacity, an equipment working 12 hours would be 240 tons capacity, and an equipment working 24 hours would be 120 tons capacity.

It must also be remembered that it is not good engineering practice to rely on one equipment of this character for the entire supply of a station. The final judgment as to the best capacity applied to this problem was to provide two duplicate coaling equipments, only one to be installed at first, each equipment to have a maximum capacity of 300 tons per hour, or be able to supply maximum coal requirements in a 10-hour working day. This gives reliability even under breakdown conditions, as each tower can supply the plant with coal. When desirable, both towers can work at the same time, supplying maximum coal in

5 hours, provided that barges laden with coal could be supplied and moved with sufficient rapidity.

In the foregoing discussion of capacity, the question of barges was omitted for simplicity. The fact is that in the installation in question, the supply of coal and barges and the movement of barges generally limit the quantity of coal that can be unloaded in a given time.

When it is necessary to trim barges, that is, to clean the coal off thoroughly, as when the barge is to be used for another coal customer, considerable time is required in addition to the unloading rate of the equipment.

To enable operators to shift barges rapidly, several powerful electric winches were installed on the dock, provided with nigger-heads, around which the barge two-ropes are wrapped to provide the required movement.

Choice of General Character of Equipment to Do the Required Work

A wide range in character of equipment existed, with which coaling could be done.

At the time that the coaling problem which we are considering was acted on, an older boiler-house at the same location was supplied with coal by an electric traveling bucket, with an operator in a traveling cab. The cab and bucket traveled together over the bunkers and out of the house over a steel gantry to the water-front, where the bucket was lowered to grab its load of coal from the barge. The bucket was then hoisted and returned over the bunkers to discharge its load. This method was extremely slow, requiring 3 minutes per trip and giving a capacity of about 40 tons per hour. The gantry was originally designed to pick up coal from storage, but this feature was never used, because of the unreasonably slow operation that would result and practical difficulties in moving the gantry.

Before modern equipment could be supplied to the new boiler-house it was necessary to provide some temporary device to get coal into the new house. This was accomplished by erecting a common construction stiff-leg derrick on the water-front, which unloaded coal from barges, dumping it into an elevated crusher. The crushed coal was taken by side-dump trolley cars on the ground level to a skip hoist, which elevated coal to a point above the boiler-house roof. Another trolley car carried this coal from this point over the power-house roof to the new house.

In choosing permanent coaling equipment for the new house the gantry type was eliminated because of its slow operation. The low-type unloader with cars and skip hoist and belt distribution over bunkers was proposed by a firm manufacturing coal-handling machinery, but it was rejected because of multiplicity of parts. The equipment finally determined on was a high-speed coaling tower, located on the water-front, with a structural steel boom overhanging the water. A bucket grabs coal from the barges and lifts it into a receiving hopper 105 feet above the water. From this hopper the coal passes through a two-roll crusher and into another hopper directly above a cable railroad. The cable railroad is on the level of the top of coal bunkers in the boiler-house to be served. The cars are circulated in an endless route from the coaling tower over a bridge to the boiler-house, their load of coal is dumped in the proper bunkers without stopping, and the cars return to the coaling tower to be loaded.

This equipment, it will be noted, is perhaps as simple as possible. All the elevating is done in one lift when the coal is picked up from the barge. Gravity then causes the coal to flow through hoppers and crusher to the cars. Horizontal transportation is done entirely by cars which are most reliable and efficient for that purpose.

Specifications to Cover Construction and Performance of the Various Parts of the Structure and Equipment

Having chosen the general character of coaling apparatus, it is now necessary to specify construction and performance required of its several important component parts.

No engineer can sit down and evolve complete specifications for highly developed equipment. It is folly for any engineer to attempt to quickly master the multitude of great problems that are involved in a large installation of electrical and mechanical equipment. The proper method, and one almost universally followed, is to call upon manufacturing and constructing concerns for their proposed specifications for equipment and construction to accomplish the desired purpose.

In the case of the coaling tower under consideration, it was necessary to turn to outside concerns for the following:

(a) Caisson foundations
(b) Structural steel tower and bridge
(c) Coal-hoisting machinery
(d) Cable railway cars and drive

To obtain best results, of course, it is necessary to invite the most reliable and capable firms to bid. If the engineer is in doubt who is best fitted to do certain work, or supply certain equipment, he can get such information from several convenient sources.

The advertisements of trade journals are constantly revised lists of bidders. The engineering society journals carry announcements and advertisements of capable firms. From these and other sources of information the engineer can quickly cull, if he does not already know, the names of proper parties to confer with on the prospective work.

For competition it is, of course, necessary to have two or more bidders. It may be advisable to have as many as five if there are that many entirely competent parties. Beware, however, of inviting the irresponsible or incapable bidder. He will make promises he cannot fulfill, or quote a low price which will not see him through the contract, and then abandon the work. The character of a contractor is important. One will haggle at every doubtful point and seek extras at every turn. Another will fulfill his contract without question and give his client the benefit of the doubt.

A good rule in the selection of bidders is to invite only those whom you are willing to have do the work, and treat them all impartially, awarding the contract to the one offering the best proposition, all things considered, which does not always mean the proposition of lowest price.

We will now turn to the several parts of the structure and equipment under consideration.

Caisson Foundations.—The foundation problem for the coaling towers was serious because 50 feet of silt overlaid bottom of satisfactory character, and this silt was slowly moving, carrying with it any ordinary structure supported on piles driven through the silt. It was found necessary to sink four 10-foot diameter concrete caissons 70 feet deep, penetrating the hard bottom for about 20 feet, making a solid and immovable foundation for the steel structure. The two most experienced foundation concerns in the country were turned to, with the result that one company built the caissons for the first tower, and the other company the caissons for the second. By turning to the engineering and construction firms best fitted in this country for this work, we not only secured permanent structures, but were ourselves relieved from the serious responsibility of providing foundations that might fail under adverse conditions.

Structural Steel Tower and Bridge.—The steel structure for tower and bridge was roughly designed by the owner's designers; that is, the general size and character of the structure was determined and loading given. The result is called a setting plan. This drawing or setting plan was then submitted to the structural steel firms for competitive bids, it being specified that the successful bidder should completely check the design and be responsible for its strength, and detail all of the parts. The price in such cases is given on a tonnage basis, so that moderate changes in design or size of members will not affect the contract.

Structural steel is sometimes let for delivery only, painted one shop coat. This was done in the first tower because of the unusual difficulties of erection over water. An erecting company made a better proposition than the firm supplying the steel.

It is generally better to include erection in the steel contract, as this avoids division of responsibility for errors between the fabricator and the erector. This method was followed in letting the contract for the second tower.

The steel structure is simple, consisting of a comparatively few clean, heavy members. This feature shows a modern tendency to use a single heavy member for both tension and compression instead of two tension members. It produces a neater structure less liable to rattle, and requiring less attention for up-keep.

Coal-hoisting Machinery.—In drawing up specifications for hoisting machinery, the few leading manufacturers of such machinery were asked for specifications and prices. Complete information as to our requirements were submitted to them, and conferences were had with their engineers,

Here it is important to note that a personal conference with capable engineers of a manufacturer will accomplish more than weeks of corresponding. It is also highly desirable to have the contracting engineer familiar with conditions on the site.

A careful survey of manufacturers' specifications led to the choice of equipment as follows:

A 2-ton clam-shell bucket is used. The hoisting rope is operated by a drum driven by a powerful direct-connected electric motor. The outward travel of the bucket is accomplished by a trolley carriage on the boom, this carriage being hauled out by a separate trolley drum and motor; the inward travel of the carriage is caused by the weight of the bucket when the brake of the trolley drum is released. Both hoist motor and trolley motor are 3-phase, 440-volt. When the bucket is lowered, its weight causes it to fall almost like a free body until the motor on the drum shaft is driven at over synchronous speed, when regeneration occurs, sending energy back into the supply system and limiting the speed of the falling bucket. To stop the bucket, a powerful water-cooled brake is applied, producing a shock to the tower and equipment often greater than the shock produced by full hoisting torque when the loaded bucket is picked up from the barge.

Impact.—This action of stopping the falling bucket is a good example of impact stresses, which are generally far in excess of dead-load stresses. The kinetic energy of the falling bucket when stopped abruptly by a powerful brake is almost equivalent to a hammer blow. The entire structure and equipment must be designed to withstand these stresses with an ample factor of safety. The hoisting rope, boom, boom-guys, trolley-hoisting drum and tower are all subject to the impact, which is controlled by the design and adjustment of the brake.

Engineers of manufacturers are ready and anxious to explain the design and merits of their apparatus, and by giving each bidder an attentive hearing the purchasing engineer can gain valuable knowledge of the apparatus offered, with minimum expenditure of time and effort.

Cable Railway Cars and Drive.—Several makers of cable cars, those having the most experience in handling coal, were followed in their standard specifications for this equipment. Side-dump 3-ton cars were chosen, loaded by two large hand-operated coal valves in the coaling tower and provided with hand-operated cable grips for starting and stopping, and also for changing over where the cable goes to the driving machine. After a short period of operation it was found that considerable time was lost in the loading of cars and also in changing over by hand where the cable changes. These difficulties were overcome by substituting a very large air-operated coal gate for loading. This valve has a clear opening of 2 feet 6 inches by 4 feet, and fills a car in from 3 to 5 seconds.

An automatic device was later installed for ungripping and regripping where the cable changes. This greatly increased the speed of operating the coal cars, which had been the limiting feature of capacity. These changes are mentioned as examples where a greater familiarity with the latest and best installations might have avoided subsequent changes and given better satisfaction from the start. The manufacturer in specifying a hand-operated loading valve and hand-operated grips was doubtless influenced by a desire to hold down his competitive price and get the order. In this case neither manufacturer originally offered these automatic devices. The engineer in charge should, therefore, remember to inquire for possible improvements beyond what the manufacturer's specifications may contain.

Automatic Equipment.—In drawing up specifications it should be remembered that labor is in general the most expensive item in operation, and where it is possible to eliminate a single laborer at a wage of $3.50 per day, or, say, $1,000 per year, an investment as high as $5,000, or even $10,000, may be justified. Interest and depreciation on the investment should pay the laborer's wage, and operation will in general be more reliable and rapid than with the laborer. It will often be found that the value of more rapid operation is greater than the saving in operating wages.

Capacity.—The capacity of any plant or process is limited by the capacity of the weakest link in the chain. Thus in the coaling system under consideration the capacity may be limited by any of the following: the coal supply or barge supply,

or the movement of barges; the coal hoist or bucket or trolley or the skill of the operator; the hoppers or coal crusher or coal gate, or, finally, the cable road or cars.

It is necessary to consider an entire chain of operation to insure that no weak link will limit the capacity of the entire system.

The skill of operators is also an important factor and should be eliminated where possible. In an operation such as coal hoisting, an expert operator may easily lift twice as much coal as an inefficient man, and there are relatively few men who have the natural qualities to make an A-1 operator.

How a Portable Mixing Plant Was Used to Solve a Construction Problem

WHEN constructing the 6½ miles of 12-duct subway between Union and Passaic, N. J., and the 2¼ miles of 24-duct subway between Jersey City and Newark, N. J., the New York Telephone Company was confronted with problems which compelled some radical changes in equipment.

The construction of the subways was of multiple duct tile with a concrete foundation and concrete top protection, and all manholes were built entirely of concrete. The road on the Union-Passaic job being very narrow and lined with swamps on both sides, the mixing of this concrete would have necessitated the building of platforms in the swamps for the mixer and material about 500 feet apart and at a very high cost. This concrete mixing plant mounted on an automobile truck was the answer.

The outfit consisted of a power batch concrete mixer mounted on a 7-ton Packard motor truck, which was also equipped with two gravity hoppers, one for sand and the other for stone, in addition to a tank for water. The materials for the concrete were gathered at a convenient place on the job, and the sand and stone loaded into the hoppers by a scoop conveyor, manufactured by the Portable Machinery Company, Passaic, N. J., and shown in one of the illustrations. Bags of cement were also put on board, and fully loaded; the outfit carried material sufficient for 5 yards of concrete.

The power mixer was fed by a laborer on the truck shoveling sand and stone from openings at the bottom of the gravity hoppers. The concrete was poured directly into the truck or manhole excavations by means of a spout. The truck driver, with a little practice, found it possible to regulate the forward movement of the truck to give the required thickness to the concrete in the truck, so that little hand-spreading was necessary. The saving of this equipment on this job was very great.

On the Jersey City-Newark job, although it was possible to mix the concrete in the usual way at stations along the trench, the use of the automobile mixer was found to be about 25 per cent cheaper than the fixed concrete mixing stations and the dumping of concrete into the trench and manhole excavations from wheelbarrows.

Loaded Truck Gains 168,000 Miles over Team in Five-Year Haul

By W. A. Carpenter

WHILE very much has been said upon the subject of horse versus motor truck, the following comparison will illustrate in a striking way the difference between the two methods, and may present the matter in a new light.

The average two-horse team will haul 2 tons over the average road at a speed not greater than 3 miles per hour. Allowing one hour for the noonday stop, and another hour for loading, unloading, resting on grades, and miscellaneous delays, it is safe to say that the team will in a 10-hour day cover not more than 24 miles. But at least one hour in the early morning before starting on the trip, preferably longer, must be allowed for the horses to be fed, curried, harnessed and watered, also part of the noon hour must be devoted to care of the horses, and at night after working hours some little time must be devoted to feeding, watering, bedding and currying them. All of this extra work must be done outside of the 10 working hours, to say nothing of veterinary services.

With the truck, no preliminary work is necessary except a few moments' inspection every morning, desirable in any piece of machinery. Allow the same two hours' lost time each day for truck as allowed for team, though the hour allowed for such delays will be confined to loading, and the greater part of this time loss will be eliminated. At the close of the first day the truck will be 136 miles from the place of starting. (Remember the team has made but 24 miles.) At the close of 300 days, the truck will be 40,800 miles from the starting point, though during the 300 days the team has covered only 7,200 miles. In other words, the truck has carried 2 tons 33,600 miles further than the team did in the same length of time. Keep this up, for say, five years,—if the horses are able to work steadily 300 days per year for five years,—and we find the truck 168,000 miles ahead of the team. Counting feed, care and up-keep of team, harness and wagon, the cost of operation and maintenance is about the same for the truck as for the team.

Hence, there can be no argument concerning the efficiency of the two methods of hauling. The investment, of course, is much greater with the truck than with the team, but, as will be seen from above, the results are not favorable to the use of the horse.

Arkansas Roads Built by Motor Trucks

U. S. MOTOR TRUCK FOR ROAD WORK

The illustration herewith shows a Model R U. S. motor truck equipped with pneumatic tires and contractors' dump body of 6,000 pounds capacity. This particular truck is used in road construction work in Arkansas by the Southern Improvement Company, at Little Rock, Ark. This company has been using U. S. road building trucks with excellent results, having standardized on this equipment alone.

Two of these trucks were driven from the factory at Cincinnati to Little Rock for delivery. The trucks arrived in first-rate condition and were put to work immediately. Many other contractors have had similar experiences.

Flood Lighting for Night Work

For Speed, Safety and Availability Electric Projectors Are Particularly Valuable

AT the present time, when contractors are being called upon to do a large amount of construction and repair work at night, the question of the best form of illumination is one of considerable interest.

For such classes of work, where it is a matter of lighting large areas distinctly, flood lighting by means of incandescent lamps and projectors is admirably suited. This form of illumination, which has been brought to a high state of development by the General Electric Company, may be described as search-lighting on a small scale. The difference is that it brings a near-by area into clear view, instead of being concentrated on some object miles away.

NIGHT VIEW OF CONSTRUCTION WORK ON A LARGE FACTORY SHOWING EFFECTIVE LIGHTING BY INCANDESCENT LAMPS AND PROJECTORS

Other features tend to make flood lighting desirable. Aside from the increased safety and convenience which its use obtains, are its cheapness, ease of installation, and saving of power. In considering the first of these, its comparative cheapness is due to the saving in the cost of copper. Since wires do not have to be run all over the job, and since one lighting unit will replace a number of incandescent lamps, there is a saving in the number of lamps. Further, since the unit is extremely efficient because practically all the light of the lamp bulbs is utilized, and all light projected is placed where wanted, there is a considerable saving in power. As for ease of installation, the character of most building jobs renders it difficult or impossible to run wires to every place where light is needed, and it is also more or less impractical to have poles all over the place. By the use of projectors, the main source of light is concentrated at one or a number of points that may be at some distance from the actual area to be illuminated. From these stations the flood lighting projectors may be so directed as to illuminate those points most in need of it.

As to safety, a job is safe in direct proportion to the clearness of the illumination furnished; also, men can work better and faster in good light.

The character of projector to be used depends entirely upon the class of lighting desired. For lighting large areas, the type L 15 projector, which gives a very wide beam and well-diffused light, is the one which is best adapted. Standard 110- or 220-volt, 300- to 1,000-watt lamps can be used with it. While it is adaptable to all types of flood lighting, it was especially designed for lighting such places as shipyards, railroad classification yards, and construction work.

The Cost Factors of Engineering Practice

By C. H. Young
President, Central States Engineering Company, Muscatine, Iowa

IN analyzing the cost of engineering practice, it has been discovered that cost factors are of great variety and are dependent upon the class of service that the engineer performs. There are involved, also, the type of organization, the kind and extent of trade area tributary to the locality within which the engineer functions, the amount of energy spent in educational work of clients and of the engineer, himself, in continuance of business, the manner of development, and the period of development. There appears to be no general method of procedure adopted by engineers, and it is therefore impossible to make a standardization of factors applicable to every case.

Classes of Engineers

It is consequently necessary to divide engineers into seven classes.

The *Class A* engineer may or may not have a technical education, has his office at home and operates a one-man practice.

The *Class B* engineer has a small office, employs assistants part time, and operates the rest of the time in one-man practice.

The *Class C* engineer has a business organization, a stenographer, a chief engineer, and departments, employing a number of men in order that he may perform various classes of service.

The *Class D* engineer holds some position which provides office equipment and salary and devotes part time to private practice.

The *Class E* engineer is a professor who devotes excess time to private practice in order that he may gain such experience as will enable him to be better qualified to teach the subject which he has in hand.

The *Class F* engineer consults only on special projects and confines himself to development only on large projects along a particular line.

The *Class G* engineer does some contracting and fills in his time practicing engineering.

Cost of Engineering Education

It seems proper at this time to discuss somewhat the cost of an engineering education, because this is the foundation for a lasting superstructure of engineering practice. Considering that the cost of a college education is $500 per year and that some classes of engineers would require a four-year course and some six years, some engineers acquire a larger part of their education through their personal ability to study out problems in their own way. So the factor of education fluctuates in that it depends upon a man's ability to apply his knowledge practically before it can be ascertained what the value of that knowledge is to his business. In general, however,

Class A requires 4 years at $2,000; practical experience $1,000.
Class B requires 4 years at $2,000; practical experience $1,500.
Class C requires 4 years at $2,000; practical experience $3,000.
Class D requires 4 years at $2,000; practical experience $5,000.
Class E requires 6 years at $3,000; practical experience $3,000.
Class F requires 6 years at $3,000; practical experience $3,000.
Class G requires 4 years at $2,000; practical experience $2,000.

It has been computed that 25 per cent of their time is all that classes D and E can devote to practice because of other duties. In considering practical experience, a 5-year period has been used.

NECESSARY EQUIPMENT

Class A, tools and fixtures, transportation facilities $2,000.
Class B, tools and fixtures, transportation facilities $3,000.
Class C, tools and fixtures, transportation facilities $1,500.
Class D, tools and fixtures, transportation facilities $3,000.
Class E, tools and fixtures, transportation facilities $1,000.
Class F, tools and fixtures, transportation facilities $2,000.
Class G, tools and fixtures, transportation facilities $3,000.

Continuance of Business

Ordinarily, the first year of Class A's time furnishes the engineer 50 to 70 per cent employment; the second year, 60 to 80 per cent employment; the third year full time. After the third year, he usually enters into Class B and continues with 50 per cent assistants the fourth year, 75 per cent assistants the fifth year, and full-time assistants the sixth year. If he is successful and energetic and has the proper personality and natural ability, he will enter

the seventh year with more than one assistant and be in Class C. In the tenth year of practice he has good chances of operating three or four departments, if he is energetic.

It may be necessary some time during this career for him to enter Class D in order to fill in part time in some position, or he may be side-tracked into Class E for a time or permanently. There is also a chance of side-tracking into Class G, but very few engineers reach Class F until after long years of experience. Very often a Class E man starts in Class A and develops more rapidly, arriving usually in Class F after he has the business ability. It seems necessary to discuss this question because these facts are the foundation for considering the cost factors in engineering practice, and almost any formula which might be created would consist almost wholly of variables. In solving for X, which would represent the income of the various classes, only general statements can be made, which would be modified by the various conditions entered into. It can be said, however, that there are items which enter into almost every practice which may be enumerated as follows:

Promotion Expense.—This item covers the expense of promoting jobs, dues to associations, etc. It is necessary for the engineer to keep up with the times in order that he may better serve his clients, just as any lawyer, dentist, doctor, or other professional man must acquaint himself with the newest ideas. He must also watch the change of personnel of different bodies of men and keep them in touch with his qualifications in the work he is doing, in order that the best interests of his business may be perpetuated.

Bonds.—This item represents the cost of surety bonds, which amounts to 1 per cent of the penalty of the bond, or 1 per cent of the bond required. As the amount of the bond furnished is fixed by the parties requiring the bond, this is an indefinite expenditure. The amount of the bond is paid by the engineer and is an item of expense.

Insurance.—This item represents the cost of workingmen's compensation, which is compulsory under state law.

Traveling Expense.—This item represents the expense of traveling to jobs one does not get, and of visiting jobs under construction, in order to secure information. There are many trips necessary in order to get final settlement on the work after it is completed. This also includes expenses to society meetings in order to keep up with the times.

War Tax.—This item must be added to all costs, as it represents the tax not only on profits but also on telephone, telegraph, and express bills.

Interest on Investment.—This item must be a part of all estimates of cost, amounting at present to 7 per cent.

Interest on Jobs.—This item is not interest on investment, but interest only on money borrowed to carry on jobs during the process of the work. Engineers must receive their wages, and expenses must be paid, whether or not collections are made. Very few assistant engineers have enough money to wait until preliminary expense is paid. Again, a great many warrants must be discounted from 1 to 4 per cent, dependent upon the credit of the project, before the banks will cash them, because the banks have to hold these warrants until the bond issue is put through. Many warrants are marked "Not paid for lack of funds."

Discount.—As mentioned above, it is sometimes necessary to discount warrants and hold bills between board meetings. Sometimes one cannot cash these warrants for several years.

Job Expense.—This item includes miscellaneous transportation of men; expense of lost time for men who receive steady pay; storage, job office rent, etc.

Repairs.—This includes the cost of repairs to tools and equipment, and tools lost or stolen.

Depreciation.—Every engineer must provide for depreciation on his equipment, which amounts to 10 per cent per annum on the cost of the equipment. In some cases this should be doubled.

Risk.—This factor is indeterminate. Sometimes during preliminary surveys the bills are not paid. The preliminary bond sometimes is insufficient, or the work is held up by legal procedure so as to be detrimental to the engineer's pay. The money must often be borrowed for an indefinite time to carry on business and discounts. Fees for testimony at $1.35 to $4.00 per day can be enforced by law.

Office Expense.—This item represents stenographer, rent, light, heat, janitor, postage, telephone, telegraph, control systems, books, supplies, advertising, and expenses of like nature.

Salaries.—The question of salaries is a local one and is easily determined by a summation of the salaries paid during the year, but it is hard to anticipate just what salaries should be paid on any particular job, because of the fluctuation of the other factors involved. One can draw general conclusions only after a definite experience in a particular locality and after a careful computation of costs and the various factors involved, before he can determine what is a fair amount to pay in salaries. It is often hard to tell until after several months into the next year's business what the profit of the business is, and until all the collections have been made for the previous year. Sometimes accounts of one year will not be paid for months after the year's work has been completed, therefore the determination of profit cannot be ascertained definitely until one knows whether or not he has any bad accounts. Many a business has failed, not because there was no profit in the execution of the work, but because of uncollectible accounts.

CENTRAL STATES ENG. CO.
DAILY REPORT

Client's Name_____ Date_____

Employee's Name_____ Hrs. Worked____

Nature of Work_____

Expense	Amt.	Paid	Remarks
Auto			
R. R. Fare			
Transfer			
Brdg. Toll			
Meals			
Lodging			
Stakes			
Stationery			
Misc.			

Remarks_____

Method of Cost Keeping

The method of cost keeping which has been adopted by the Central States Engineering Company is to make out a ticket in duplicate for each job performed each day. We file one of these tickets under the client's name, and one ticket under the employe's name. From these tickets under the employe's name we make up his salary, and from the tickets under the client's name we make up the client's bill, which may consist of the work of several men. These tickets are 3 x 5-inch and can be filed away in an ordinary card index box. They are made up in little books, 50 to a book, and each man makes out his own ticket. Below is a copy of the form used. No material is secured without an order, and this keeps the record of the amount of materials purchased on the stubs of the order book. In this way, it is possible to keep account of every transaction and every item, whether it be transportation, time on promotion, traveling expense, or any of the items above enumerated.

One factor that is indeterminate but must be taken into account is the loyalty of the employe and his abidance by the ethics of the profession. Often this item is very large when one has to keep training men over and over again to fill the different departments of the work. While it is always a source of gratification to see one's employe advance, there becomes a limit to the amount of salary that can be profitably paid. One year may be a good year and the next year a bad one, so that the cost of doing business may fluctuate with business conditions, and the employe, not having the facts at hand, may jump at conclusions and attempt to supplant the employer after having been nursed and fed to a healthy condition. As a usual thing, this class of employe receives the same treatment when, in later years, he fills the shoes of his employer.

Profit-Sharing Plan

Whether or not the employe should receive an apportionment of the profit depends upon his loyalty, his attention to business, the success of his work, and the class

CENTRAL STATES ENGINEERING CO.

OF MUSCATINE, IOWA

IN ACCOUNT WITH

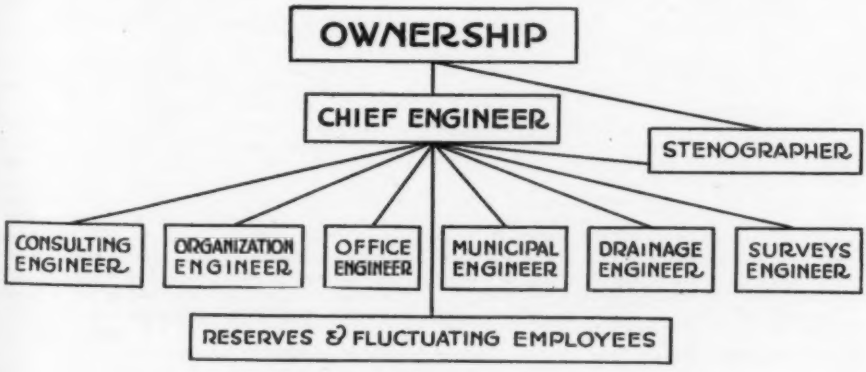
YEAR MONTH	Date		Chief Engineer	Asst. Engineer	Draughtsman	Field Helper	Transportation	Meals Lodging	Miscellaneous	TOTAL

of service the engineer performs. And again, it depends upon the value of business over a period of years, taking the good years with the bad years, the successful collections of accounts, and the education of clients. This factor of education of clients fluctuates greatly with the need for it. Any business, however, needs to educate its clients. Very few clients understand the functions of an engineer, because they would almost need to be engineers themselves in order to realize what is necessary to produce certain results. The client of an engineer is just like any ordinary man who goes to our legislature; he cannot be expected to be versed in every question from the boll-weevil to the flying machine, but he must inform himself upon various subjects in order to determine his course in voting. If an engineer does not give his clients a conception of engineering service, he cannot expect much business. It is my opinion that the education of clients is one of the largest factors of cost which enter into the engineering practice.

Organization Outlines

Engineers operating in Class C, especially, must devise some operating plan and feed it down to the different departments in some systematic method. There is a cost factor here, then, for devising ways and means to economically transmit the responsibility to the various departments. Quite a bit of money can be saved clients where men in different departments are experienced and advanced in a particular class of work, thus rendering competent service which could not be given by one engineer, who would not be versed in all kinds of engineering business. This factor, then, would aid in the economic carrying out of a project of larger magnitude. Below is given an organization outline which might be a factor in successful operation, consequently a factor of cost.

ACKNOWLEDGMENT.—From a paper presented before the 1921 convention of the Iowa Engineering Society, Des Moines, Iowa.

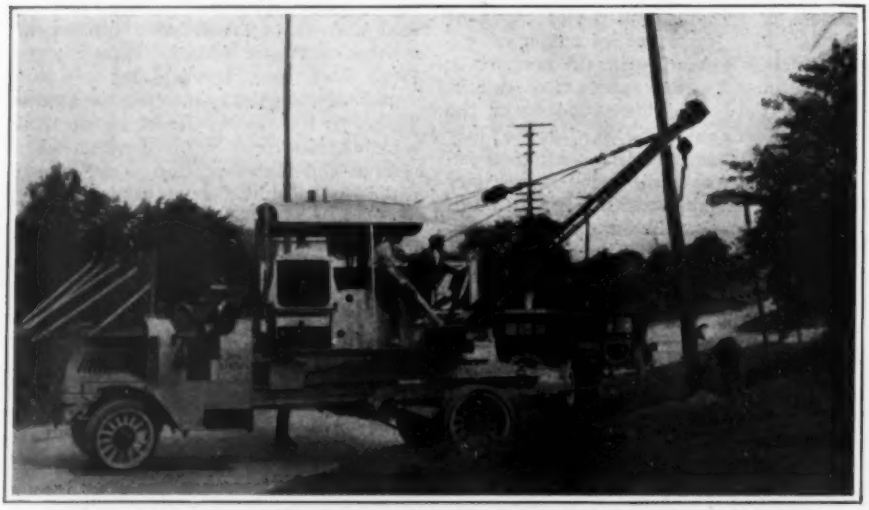


ORGANIZATION PLAN OF CONSULTING ENGINEERING COMPANY

A Truck-Mounted Crane

Facility of Movement Makes This Machine Suitable for Great Diversity of Work

BECAUSE of the demand for extreme portability in freight handling and contracting machinery, a portable swinging crane of the locomotive type which can be mounted on a motor truck has been developed. The illustrations given herewith depict a 4-ton crane mounted on a 7½-ton Mack chassis. The crane is the full-swinging type, rotating through 360 degrees, is self-contained, and is driven by a separate, water-cooled, 4-cylinder engine, with large fly-wheel capacity to handle the sudden application and release of the load. It is demountable, permitting the truck to be used for other purposes. The design of the crane follows the usual lines and has been developed and built by the Universal Crane Company of Cleveland, Ohio, for the International Motor Company, New York.



CRANE MOUNTED ON MACK TRUCK HELPS SOLVE MANY CONTRACTOR'S PROBLEMS

The crane has a capacity of 3 to 4 tons and is designed for ordinary lifting. It is fitted with a hoist block and hook for a ½-cubic-yard clam-shell bucket and an electric lifting magnet. It is equipped with a 14- to 28-foot boom, depending on requirements. Its standard capacity rating with a 20-foot boom is 3 tons at a 12-foot radius, and loads of 1¾ tons may be handled at any radius up to 20 feet.

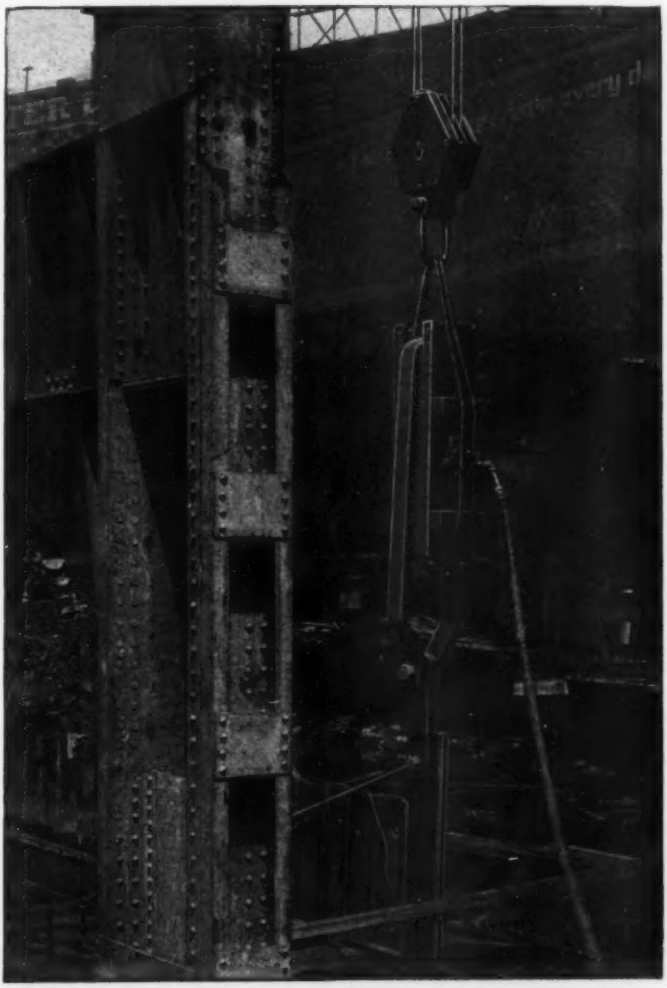
The crane is operated by one man on the platform with all operating levers in easy reach. In case the lifting magnet is used with a gasoline motor-driven crane, a plug connection to an electric line can be made, or electric equipment can be placed on the crane to supply the current. The crane without mounting or boom is approximately 8 feet 6 inches in length, 7 feet in width, and 8 feet in height from the mounting line to the top of the cab.

Manned by a crew of three, this Mack motor crane is capable of setting more telegraph and trolley poles than could be set by three gangs of men dependent on hand methods. Similar economies over manual operations are realized by using the motor crane equipment with a clam-shell bucket for unloading bulk material from freight car to pile and from car to track. Also, on excavating jobs which are not of sufficient magnitude to warrant the removing of a large and cumbersome steam derrick, this portable crane proves its worth.

A few of the uses to which this equipment may be put are: clearing street traffic of wreckage resulting from fires or collisions; loading and unloading vessels when the usual wharf facilities are lacking; unloading coal from cars to pile and from pile to truck, or directly from car to truck; setting telephone and telegraph poles; handling trolley rails; razing small buildings; excavating when the extent of the operation does not warrant the setting of a large and more cumbersome steam derrick; handling material for the erection of many types of small buildings.

The Advantages of Double-Acting Pile Hammers

IT has been well established that sheet piling can be driven faster with a double-acting hammer than with any other type. Its rapid and continued blows keep the piling in constant motion and are obviously more effective than the fewer blows of a hammer which depends upon its weight alone for driving energy. The superiority of the double-acting principle has been demonstrated frequently when hammers of various types have been used side by side on the same job. The double-acting pile hammer is particularly advantageous in driving batter piling. A drop-hammer or a single-acting hammer, relying entirely on gravity for the force of the blow, loses much of its effectiveness when its weight falls at an angle, its striking force being greatly reduced by friction. With the double-acting hammer, on the other hand, the friction incident to the position of the hammer is of minor importance,



A DOUBLE-ACTING HAMMER WORKING ON THE MICHIGAN AVENUE BRIDGE, CHICAGO

The sheet piling was 50 feet long and was in the river about a year before it was pulled, but the hammer extracted it without difficulty

since the piston is moved forward by steam or air pressure exactly the same as when driving vertically. This refers especially to the driving of heavy wood or concrete batter piles, for which large hammers are used.

For driving wood sheeting, also, there is a decided advantage in favor of the double-acting hammer. It drives much faster than other hammers and prevents waste due to splitting and brooming of the pile tops, which invariably occurs when light drop hammers or mauls are used.

The McKiernan-Terry pile hammer, manufactured by the McKiernan-Terry Drill Company, 19 Park Row, New York City, is a distinctive type, characterized by simplicity, compactness and durability. This hammer is claimed to have fewer moving parts than any other pile hammer now manufactured, and these, being entirely enclosed, cannot injure the operator in charge and are free from disarrangements which might otherwise be caused by accidental exterior damage. These hammers can be operated with either steam or compressed air. A change from one power to the other can be made without adjustment of the valves or other parts. Nos. 1, 2 and 3 of the McKiernan-Terry pile hammers are used for driving wood sheeting from 2 to 3 inches in thickness, or like sections of steel sheet piling. The depth to which they will drive in average material in advance of excavation varies according to the size of the pile hammer, from 6 to 10 feet for wood piling and from 10 to 15 feet for sheet steel piling. Further depth is reached by repeating the operation of driving, excavating, and again driving. Special features of construction of these hammers, such as the freedom from any projections, enables them to work in close quarters. This makes it possible to drive close to a wall, or, when a second course of sheet piling is being driven, to reduce to a fraction of an inch the distance between the courses. With a No. 1 hammer which measures 6 x 8 inches in cross-section, the space actually needed under such conditions is ½ inch, while No. 3, having a cross-section of 9 by 9½ inches, required ¾ inch.

The illustration on page 71 shows a No. 6 McKiernan-Terry hammer at work on the Michigan Avenue bridge, Chicago. This hammer has a net weight of 2,900 pounds, is capable of delivering 275 strokes per minute at 2,402 foot-pounds energy per blow, and has over-all dimensions of 73 by 21 by 16 inches. The sheet piling on this job was 50 feet long and was in the river for about one year before it was pulled, but the hammer had no difficulty in extracting it. This was done by simply reversing the action of the hammer.

What Does the Contractor Need?

1. Competition on projects confined to legitimate contractors only.

2. A code of ethics, lived up to by all competitors, and covering enough territory to be effective.

3. Some method of making sure that all his competitors have full quantities in their estimates, for a contractor may make a complete and correct estimate himself, but if any of his competitors have failed to take off complete quantities of material he is handicapped that much in the competition.

4. Proper, fair and safe contracts with owners on forms prepared by contractors.

5. Proper, fair and safe contracts with subcontractors on forms prepared by contractors.

6. A method of requiring manufacturers and material dealers to quote preferential prices to contractors, or to sell only through contractors.

(The material dealers and manufacturers have gotten together in many districts; in fact, a national movement is on to require manufacturers to dispose of their products, such as brick, tile, cement and plaster, only through the local dealer, the argument being that the local dealer is the natural outlet and maintains a business, hence is entitled to a profit on every manufactured article entering his town. If this is so, the contractor is the next natural outlet. He maintains a business too, and it is up to him to insist that the material dealer recognize him as the next regular outlet, or to eliminate the dealer and deal direct with the manufacturer.)

7. A healthy competition in materials.

8. A plentiful supply of competent mechanics and enough apprentices to assure a future supply of mechanics.

Orin P. Bailey, Orin P. Bailey Company, Minneapolis, Minn., in the *Bulletin* of the Associated General Contractors, January, 1921.

The Value of Catalogs to a Contractor?

Frequently you are confronted with the question of who makes a specific kind of frequently contain cost data, construction methods, and tables for estimating, which are of great value to the reader. Contractors should carefully read over the lists of catalogs on pages 53 and 54, and secure such material as will benefit them in their work.

Maintaining Park Roads

As a result of careful planning to attain the "City Beautiful," most main arteries of travel from one section of a city to another is through its parks, this produces very heavy traffic.

Quite often, parks containing hundreds of acres had their beginning in just a small plot of ground; additions were made, the management changed frequently, and as a consequence one single park may contain almost every kind of road.

To be able to repair the various roads, a large amount of equipment is required.

The beautiful parkway shown above constructed of

STANOLIND PAVING ASPHALT, "C"

has been in use for over 5 years, and at the present time it is in perfect condition, without one cent having been spent for maintenance.

We believe that no better kind of roadway for parks was ever devised than those of asphalt.

Our booklet "Stanolind Paving Asphalt" containing information regarding this type of road as well as all other asphaltic roads will be mailed free upon request.

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A Portable Screen for Gravel

Ready and Rapid Screen Replacement Makes Outfit Valuable for Producing Material of Any Size Desired

GRAVEL is one of the best natural materials for road-building purposes. A gravel bank which contains gravel in proper proportions for road building is extremely rare. Practically all natural gravel, whether it is to be used for concrete aggregates, bituminous macadam, or gravel roads, and also railroad ballast, must be screened before using. No two gravel banks or pits are alike; each varies in the percentage of coarse and fine gravel as well as in the percentage of sand, silt and other foreign substances.

A good gravel road requires a definite proportion of coarse and fine gravel and should be free from loam. A limited amount of clay is permissible; too much clay is objectionable because it dissolves into mud when there is a prolonged wet spell. For concrete aggregate the gravel should contain definite proportions of coarse and fine gravel and not over a specified amount of clay or silt.

The Portable Whip-Tap screen manufactured by The W. S. Tyler Company, Cleveland, Ohio, is built to size gravel to meet any specifications for concrete or gravel roads. It is claimed that this screen produces gravel at a lower cost than other types of similar apparatus. This portable machine combines two fundamental principles of great advantage in screening:

1. Drumhead screen tension
2. Continuous unchecked vibration

The screening surface is stretched smooth and taut—there is a direct positive tension at both ends of every cross-wire. The tension can be increased or decreased by turning a key, and the method of changing screens is such that one man can replace a screen on a frame and bring it to the proper tension in a few minutes. The wire screen is mounted on a frame that can be expanded and contracted by means of stretcher bars with right- and left-hand threads. It is this expanding of the screen frame that produces the tension on the screen cloth. The ability to rapidly change the screen makes it possible to change from the production of a gravel for one specification to that required under another specification in a minimum of time, thus reducing lost time and minimizing the loss of production and making the plant very flexible.

A WHIP TAP SCREEN IN SERVICE SCREENING GRAVEL FOR ROAD WORK

The machine is driven by a Novo non-bursting gasoline engine, and is constructed throughout to be mechanically simple so that it may be operated by practically anybody. It has been found to operate successfully under winter conditions and with wet gravel.

The Portable Whip-Tap screen is of all-metal construction with no timbers to rot or decay, and all that is necessary is an occasional coat of paint. It can be readily towed from one place to another by motor truck, tractor or horses.

The BEST Pipe (Cast Iron) With Better (Cast Iron) Joints

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WRENCHES THE ONLY EQUIPMENT

NO PACKING CALKING GASKETS

With labor recruited from the surrounding mountains, and laborers many of whom having yet to see a water-supply system, 31,500 feet of Class No. 175 Universal Pipe in sizes 4 to 12 inch, were installed at Fieldale, Va. Fieldale is located in the foothills of the Blue Ridge Mountains and its reservoir is supplied from a river a mile up in the mountains. The larger sizes of Universal provided the mains from the river to the reservoir and to the town where the smaller sizes were used for the town's domestic supply and fire protection lines.

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The Preservation of Steel Smokestacks

By J. S. Ervin

STEEL smokestacks are necessary evils. The first cost is high, hence it is obvious that every precaution should be taken to keep the stack properly covered with a protective coating to eliminate costly repairs and early replacements.

The proper preservation of stacks with a suitable coating is therefore imperative in order that the maximum return on the investment may be realized.

Because of their exposed condition, subjected to constant attacks from the elements, and because of the nature of the service which they perform, corrosion and deterioration are rapid, both on the inner and on the outer surfaces of the stack.

Every manufacturer knows the expense of replacing corroded rings, and this operation is usually possible only when the first one or two at the top have gone. Should excessive corrosion take place at the base or the middle of the stack it is very difficult to make repairs, and usually means replacing the entire stack.

If a plant is operating with only one stack, the expense of repairing or placing the rings is greatly increased, as it is necessary to close down the boilers, which means a complete shutdown of the entire plant.

With reasonable care and judicious use of special prepared stack coatings, the life of a stack may be doubled at a trifling cost as compared with the expense of replacing new rings.

The proper preparation of a new stack to receive a protective coating will not give the maximum protection, nor will it last long.

The stack should first be thoroughly cleaned of all dirt, mill scale, grease, etc., with stiff bristle or wire brushes, then primed with a special prepared primer coating of brown or black color.

Some stack manufacturers recommend as a priming coat for the stacks a coal tar paint, and others a graphite paint. We believe that either of these materials forms an unsatisfactory priming coat: the coal tar paint because it is partially soluble in water, contains corrosion producing acids, and is susceptible to weather changes; and the graphite paint because the graphite, like most dry pigments, is rather hygroscopic and tends to promote rust corrosion in the metal, rather than prevent or stop it. Furthermore, the tests of many scientific societies seem to indicate that paints containing dry pigments in almost any form are rust stimulative when applied direct to ferrous metal surfaces.

When preparing an old stack for recoating it should be thoroughly cleaned as recommended for new stacks, except that more care should be taken to see that all rust is removed and the badly corroded and bare spots touched up with a primer before applying the finishing coat.

Unlined stacks may be divided into two classes. First, those in which the temperature ranges from the surrounding atmosphere to 1200° F. in a single day; and, second, those in which the range of heat is much lower, running from that of the atmosphere to 500° F. to 700° F.

In stacks of the first class the steel plates themselves, even without the assistance of moisture, deteriorate very rapidly. It cannot be expected, therefore, that a coating which is to some extent composed of organic substances, will successfully withstand such constant and varied ranges in temperature. The only way to treat unlined stacks of this description is by frequent recoating, merely to have them protected from moisture and improve their appearance.

Stacks of the second class, where the range in temperature runs from 500° to 700° F., can be coated with considerable success by using specially prepared stack coatings such as Robertson Process Stack and Heat Resisting Coating, made by H. H. Robertson Co., Pittsburgh, Pa.

There are certain classes which are lined, such as boiler house stacks, open hearth stacks and blast furnace and heater stacks, where the heat does not run up more than 500° F. to 700° F., and by proper coating and attention these stacks can be made to last indefinitely.

The same methods can be followed with advantage for coating fire doors, boiler fronts, steam, hot water and furnace pipes, engines and general interior trim for boiler and engine houses.

Robertson Process Stack and Heat Resisting Coating is prepared specially for the preservation of all metal subjected to constant or intermittent heat, and having a pure natural hydro-carbon and high temperature mineral oil as basic materials. It will give maximum protection from corrosion and deterioration without being affected by high heat or rapid changes in temperature. For the priming coat the regular coating can be used by reducing the consistency by adding 15 to 20 per cent of turpentine, by volume.

Who Makes Concrete Mixers

Frequently you are confronted wit hthe question of who makes a specific kind of equipment. By consulting the "Where to Purchase" directory beginning on page 3 of the CONTRACTORS' AND ENGINEERS' MONTHLY your query is quickly answered.

METERS

Preventing Corrosion, Wear and Clogging

The construction is such that a ***circulation of water*** around the train is prevented. Not enough water can reach it to remove or neutralize the protective compound in which the gears revolve. Deposits cannot accumulate. Foreign materials cannot cause clogging. Wear is minimized by constant, efficient lubrication.

This enclosed gear train construction can be embodied in any 5/8, 3/4 or 1" Trident Meter, new or old, at a nominal cost. Any Water Department having conditions that cause corrosion, clogging or extreme wear, may adapt their present Tridents to the new type by simply purchasing and installing the new construction gear train unit.

It is interchangeable. Watch for further detailed discussions.

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ACTUAL concreting on the first stretch of Twohy Brothers' 280-mile concrete road in Maricopa County, Ariz., was begun November 12, 1920. Two mixers operating from what is known as the Fowler set-up, will lay the first 41 miles of 16-foot road at the rate of 1,300 feet a day before the material trestle and cement shed are moved. One mixer is seven miles from the material plant, the other, two miles.

A second plant installed at Chandler is identical with the one at Fowler. The Chandler plant began operations about January 1.

Materials are delivered in bottom-dump railroad cars. The cars are shunted on top of a material trestle and dumped direct into bunkers under the trestle, from which the tip-over batch boxes are loaded by gravity.

Sand and gravel are obtained from Tempe, where Twohy Brothers have installed a washing and screening plant having a capacity of 1,500 yards per day. Cement is received in bulk and unloaded by means of a Dracco vacuum plant arranged and furnished for this job by the Lakewood Engineering Company. The equipment, representing an investment of nearly a half-million dollars, includes four gasoline pavers with batch transfers, 18 miles of narrow-gage road track, 12 6-ton Cummings gasoline locomotives, 216 road cars complete with batch boxes and cement compartments, 8 double-truck cars, 4 finishing machines, and sub-graders, 2 bulk cement handling plants each having a capacity of 900 barrels per day, 8 scarifiers, and 1 clam-shell bucket.

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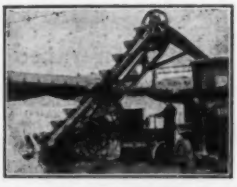

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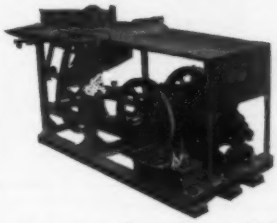

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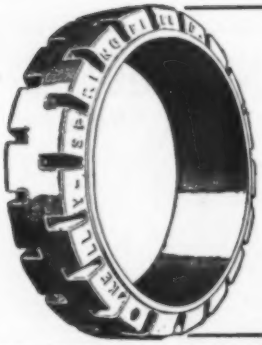

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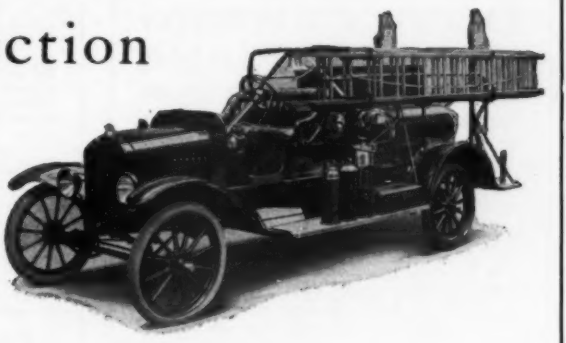

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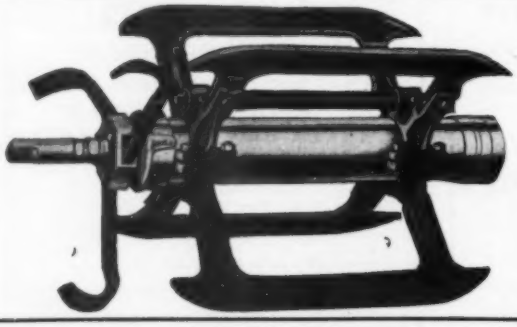

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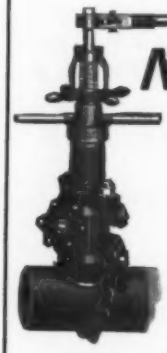

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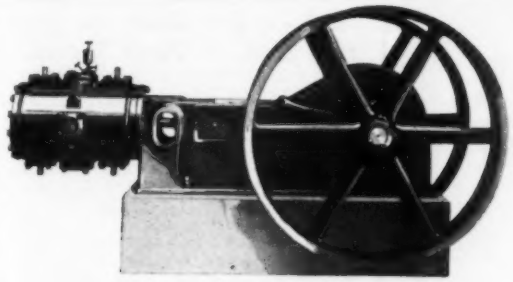

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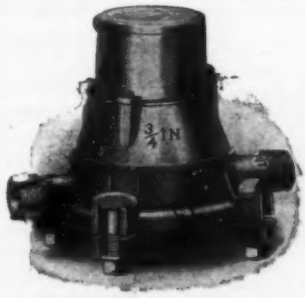

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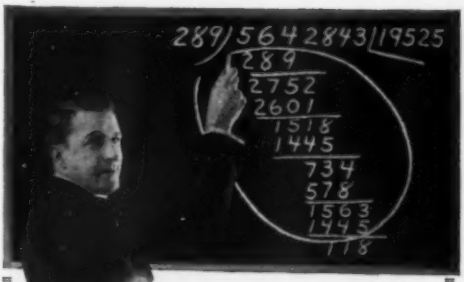

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After referring to the "Where to Purchase" Section, on pages 3 to 37, if you will look up the advertisements as per index below, you will be able to secure further data (with illustrations in many cases) on the material or equipment relative to which you are seeking information.

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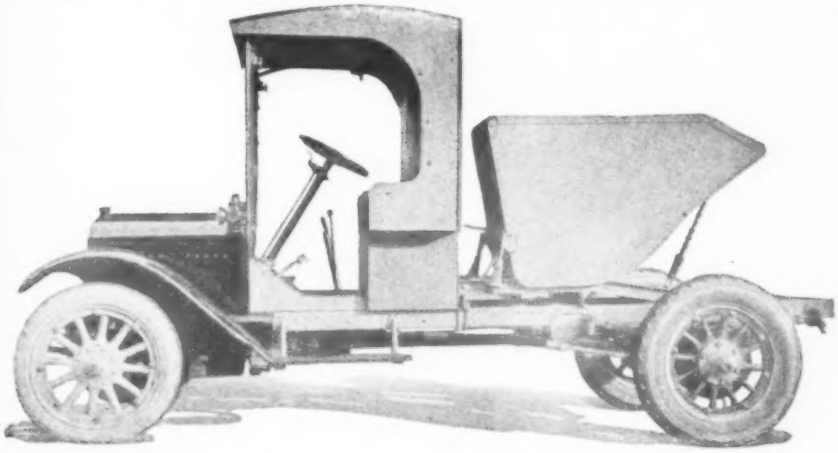
GMC

General Motors Trucks

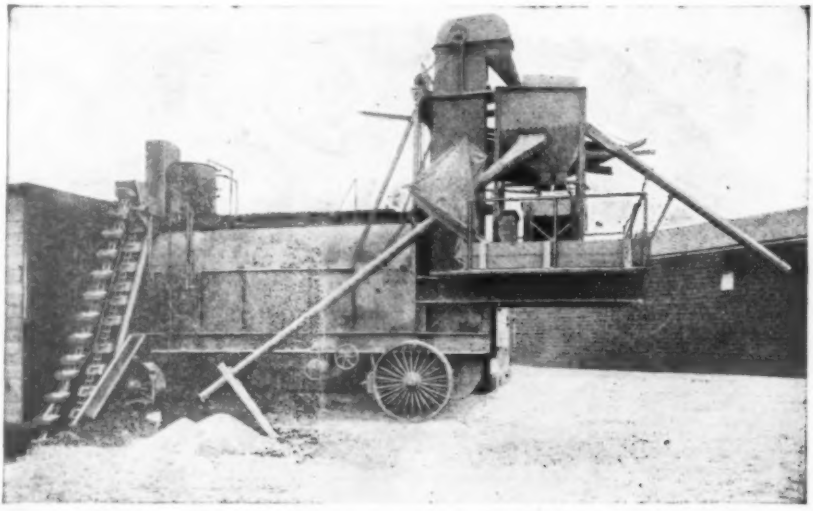


GMC Road Builder

The GMC Road Builder is a specially equipped motor truck with capacity of one yard of concrete or other material. Body so arranged that load is well balanced on both axles. The special equipment can be removed easily, leaving a regular chassis on which a standard body can be used—making it an all-year utility—This is chassis standardized by U. S. Army and of which thousands were used overseas. Ask any soldier who was in France how they stand the abuse.

Ask us for special circulars on this Road Builder—
We make trucks in all capacities from 3/4 to 5-ton.

GENERAL MOTORS TRUCK CO
Pontiac, Michigan
Branches and Distributors in principal cities



IROQUOIS PORTABLE ASPHALT MIXING PLANTS

"You can't fool the man who runs one"

HE knows that his Iroquois mixing plant is made of tested material of the highest grade and that the chances for breakdown are reduced to a minimum. That's why most of our orders come from previous purchasers or on **their** recommendation.

These mixing plants, like other Iroquois equipment, are the product of 40 years' experience in asphalt street and road building, and 25 years' experience in the designing of equipment for that purpose.

Iroquois mixing plants turn out more work at less operating cost. They furnish 800 and 1250 square yards of 2″ street asphalt topping a day.

Iroquois Portable Asphalt Mixing Plants are made in two types, with and without the power unit on the same frame as the mixer. The especial advantages of each type are described in our Bulletin No. 2A. Write for it at once.

The Barber Asphalt Paving Company

Iroquois Sales Department

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